COMBATING CORROSION

the OIL AND GAS JOURNAL

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too!

What makes a once-lively drink stale, flat and unpopular? Lost volatility. Motor fuel without **"RETAINED VOLATILITY"** gained by blending with NATURAL GASOLINE soon goes flat in performance . . . with results definitely unprofitable to you. To be sure your gasoline has the **"RETAINED VOLATILITY"** that gives consistent and uniform satisfaction to your customers, rely on WARREN'S SERVICE for the quality and quantity of NATURAL GASOLINE you need . . . where and when you want it.

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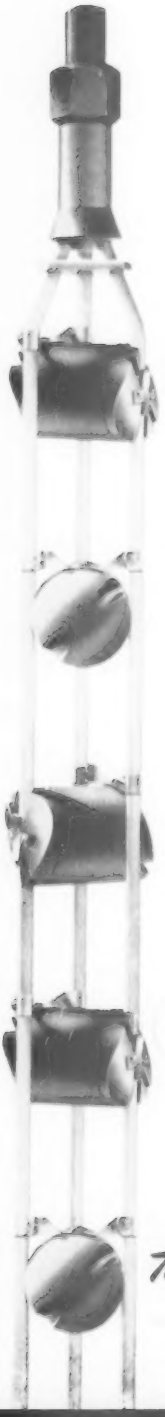
what a wallop



this lightweight packs!

When you're completing in open hole, and you want to really open up the formation for maximum production, then here's the gun that really delivers the wallop you want . . . Lane-Wells G-3 KONESHOT GUN — the lightest, safest, most powerful gun for shaped-charge perforating in open hole.

Runs in *fast* . . . upon firing, the G-3 disappears in a blast of tiny fragments which can't choke the hole or interfere with later operations. Safest because heat, pressure or well fluids cannot short out any shots . . . *all* the charges go off, *all* the gun disintegrates.

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write for further information

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In Brief . . .

1. COMBATING CORROSION . . . Here are papers by 19 leaders in the field of corrosion mitigation. Between 30 and 40 per cent of the United States annual output of steel goes to replace losses by corrosion, it is estimated. The petroleum industry's share of this expense, added to other direct costs such as labor for repair and prevention, is in excess of $600,000,000.

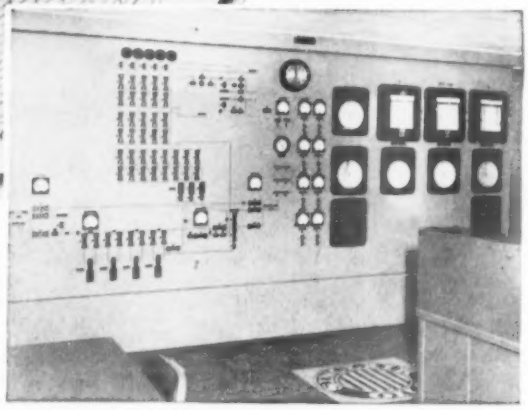
To this figure must be added the less-tangible but undisputably real losses due to shut-down time, contaminated product, inefficient operation, lost production, and damage to producing formations.

A better utilization of existing knowledge and products in the field of corrosion mitigation will help reduce the appalling waste caused by corrosion. The Journal here presents the latest information of this type.

The NEW FOXBORO M-40 AUTO-SELECTOR

This Unique Controller operates from two related measurements automatically transferring control from one to another as required to prevent either one from exceeding its set limit. When supply is greater than demand, control is maintained on the demand side (discharge) . . . but when demand exceeds supply, control is maintained on the supply side (suction).

The M-40 Auto-Selector has two measuring elements and control mechanisms — also a combined air relay. It actually does the work of two instruments . . . with one or the other variable under control at all times. The transfer of control from one variable to the other is smooth, instantaneous, and with no upset. Any type of control action may be used. Any combination of related variables may be controlled - pressure and flow; temperature and level; two flows; two pressures; etc.



SINCLAIR PIPE LINE COMPANY'S new 670 mile, 22-24 inch line from Cushing, Okla., to East Chicago is operated by all-Foxboro control instrumentation, based on the unique Auto-Selector Controller. Above: part of control panel at Cushing Station.

Write for details. The Foxboro Company, 602 Neponset Ave., Foxboro, Mass., U.S.A.

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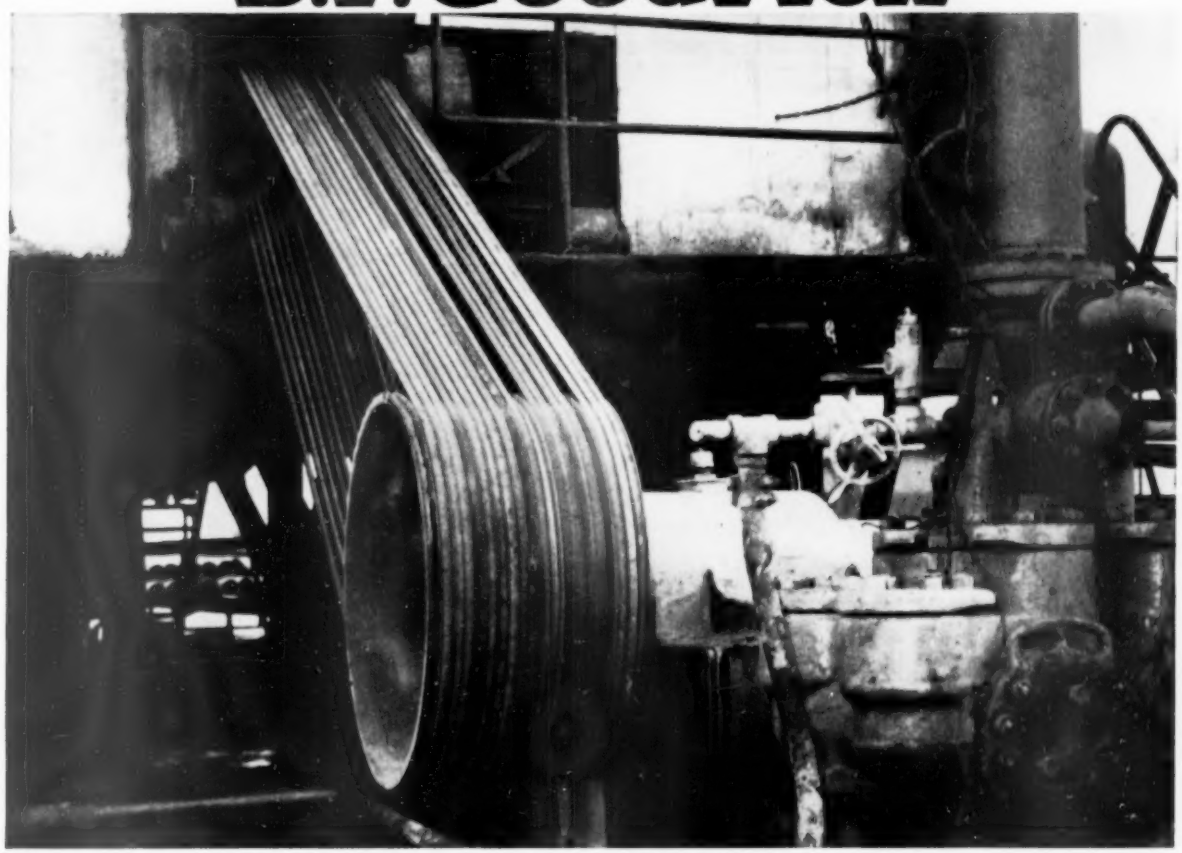
RESEARCH KEEPS **B.F.Goodrich** FIRST IN RUBBER



Grommet belts still at work after two years and 20 oil wells

B. F. Goodrich V belts last longer, yet cost no more

THOSE B. F. Goodrich Grommet V belts run the mud pump of a Texas oil drilling rig. While the average set of V belts lasts only 12 months in this type of service, the Grommet belts had been running two years when this picture was taken. And this job was their 20th well, representing a total of 142,000 feet of drilling. In spite of continuous high speed and exposure to all kinds of weather, these Grommet belts were still going strong, and were moved to their 21st well.

Strongest V belt made

No wonder B. F. Goodrich Grommet belts outlast and outperform ordinary belts. In Grommet belts, all the load-carrying cords are concentrated in twin grommets. A grommet is like a giant twisted cable except that it's endless. Since there are no center cords, the Grommet belt is more flexible, and so can "give" temporarily and absorb shock loads. And there's no overlapping cord *section* as in all ordinary belts —no weak spots to cause premature belt failure.

⅓ more gripping power

Grommet V belts have more rubber in relation to belt size. Without any stiff overlap, they're free to flex and grip sheaves better. Size for size, Grommet belts give ⅓ more gripping power with less slip, pull heavier loads with a higher safety factor.

Send for proof today

Send coupon for a set of reports showing actual installations where Grommet V belts have outlasted all others. See how you, too, can make important savings in belting, production and maintenance costs with these stronger, longer-lasting V belts.

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INDUSTRIAL PRODUCTS DIVISION

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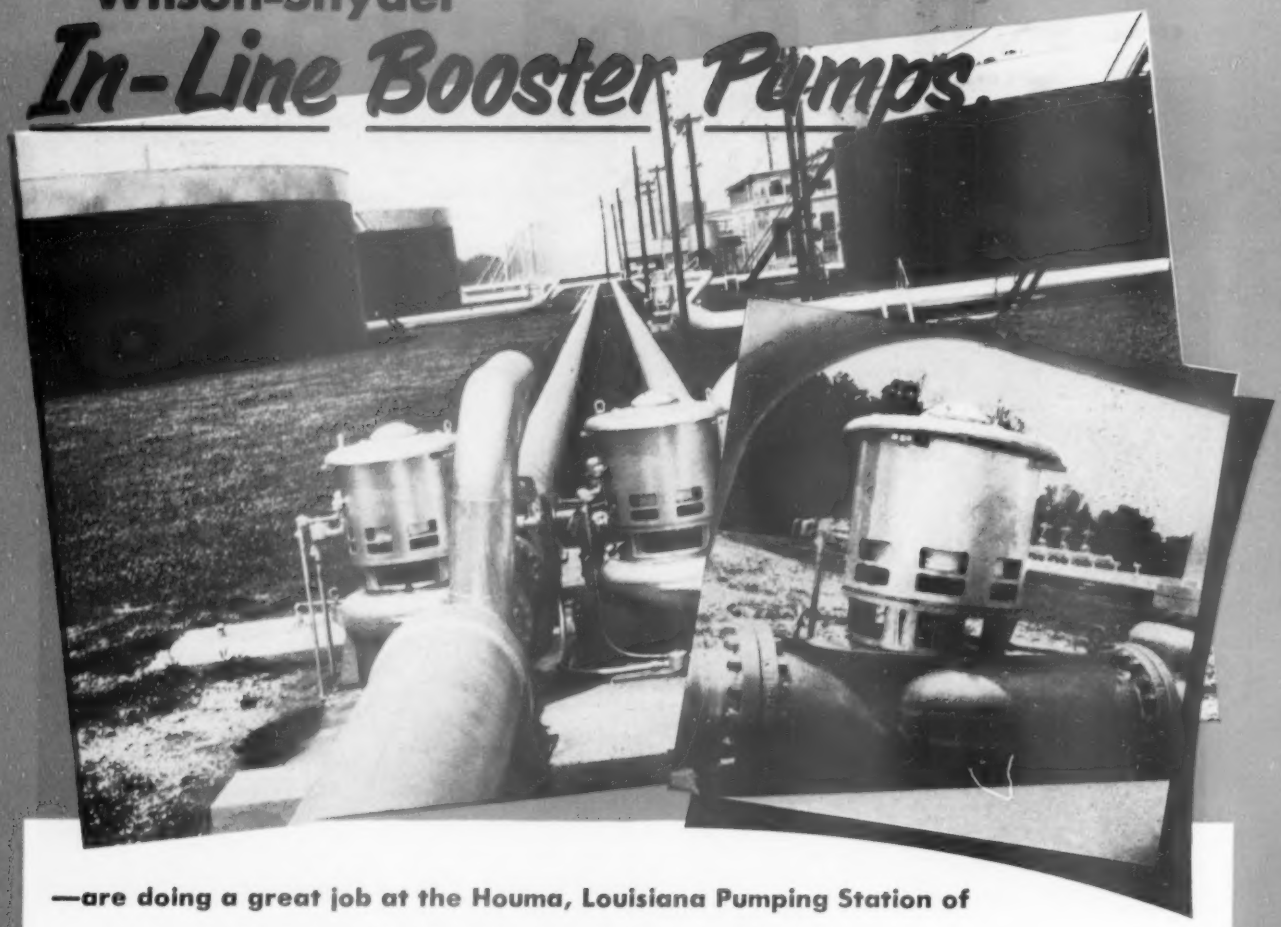

—are doing a great job at the Houma, Louisiana Pumping Station of

THE TEXAS PIPE LINE COMPANY

THE SYSTEM for transporting crude oils from the Terrebonne Bay area of Louisiana to Port Arthur, Texas, presented some unusual engineering problems, according to the engineering department of The Texas Pipe Line Company. (See WORLD OIL publication, p. 249, August, 1952 and p. 258, September 1952.)

WILSON-SNYDER IN-LINE CENTRIFUGAL PUMPS proved a most effective solution to the problem of permitting the main line pumps to maintain full capacity regardless of tank heads and different grade crudes handled. In emergencies, main line pumps can even be by-passed, as the IN-LINE PUMPS are capable of developing adequate pressure for direct deliveries to the main line at reduced flow rates.

Suction head varies for these IN-LINE PUMPS as oil levels decrease in tanks. The crude oil handled also varies from 29 to 39 A.P.I. gravity but neither of these factors have decreased the effectiveness of pump performance, according to The Texas Pipe Line Company's operating department.

Nine of these pumps are installed at the company's Houma station and four more are in operation at Erath.

Each pump is operated individually by remote control, is designed for 16" connections with vertical-electric motor, and has capacity rating of 244,800 barrels per day. These units are suitable for outdoor installations and are designed to cope with all climatic conditions encountered in Gulf Coast areas.

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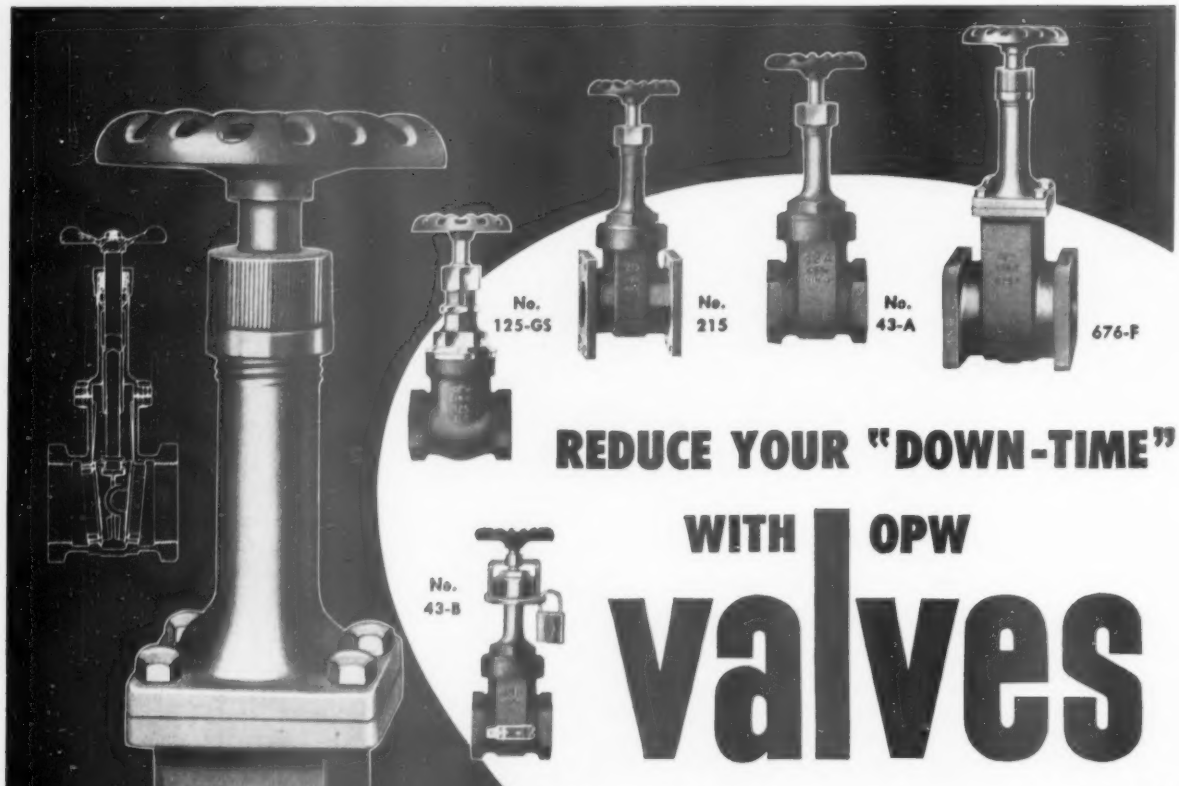

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"Down-time" frequency for valve repair is appreciably lessened with OPW Valves specifically engineered for hazardous liquid service. They are ground tighter, engineered with larger stuffing boxes, machined to closer tolerances, and produced of the finest grades of bronze and aluminum. Highest possible quality is reflected in the dependability, ruggedness and precise flow control of all OPW Valves.

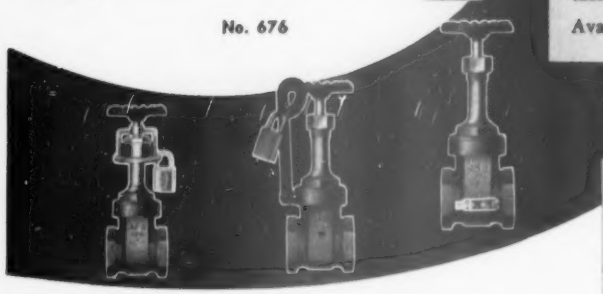
Recognizing the need and answering the demand for a valve which would reduce the tare weight of truck tanks without sacrificing peak efficiency, OPW has developed the lightweight 676. After exhaustive tests, it has been added to the complete family of OPW Valves.

CHARACTERISTICS OF THE 676 VALVE

Flanged or screw body and bolted bonnet of OPALUMIN, as strong as bronze, one third the weight. Interior parts of precision machined bronze. Ball and socket double discs, self aligning, tapered design seating against hand lapped renewable bronze seat rings for a sure, vapor-tight, no-leak closure. *Renewable seat rings are threaded and seated against shoulder,* so despite contraction and expansion of the body, the threaded ring remains seated. Compound double acting threads allow closer clearance when valve is opened, require fewer turns to open and close. Strong, large diameter stems do not bend.

Available in 3" size.

No. 676



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Here's how BOWER Spher-o-honed design lengthens bearing life... cuts maintenance costs!

The Bower tapered roller bearing design features shown on this page are vitally important to every bearing user. For they illustrate the high quality, precision workmanship and close attention to engineering detail that go into *every* Bower bearing. Even more important, these Bower design features will give you significant bearing advantages such as reduced wear, longer bearing life and lower maintenance requirements. They've been thoroughly *proved* by extensive use in virtually every type of bearing application. If your product uses bearings—whatever it may be—specify Bower now. Or better yet, call in a Bower engineer while your product is still in the blueprint stage.

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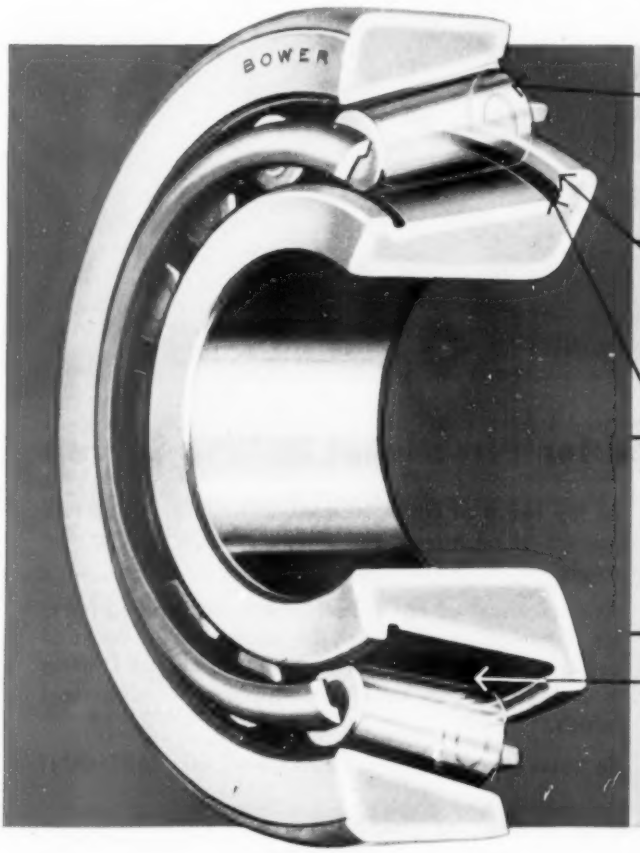

● **SPHERICAL ROLLER HEADS ARE GENERATED TO THE CONTOUR THEY ACQUIRE IN THE COURSE OF WEAR.** This helps Bower bearings hold adjustment and pre-load longer and better. Normal running-in time is virtually eliminated.

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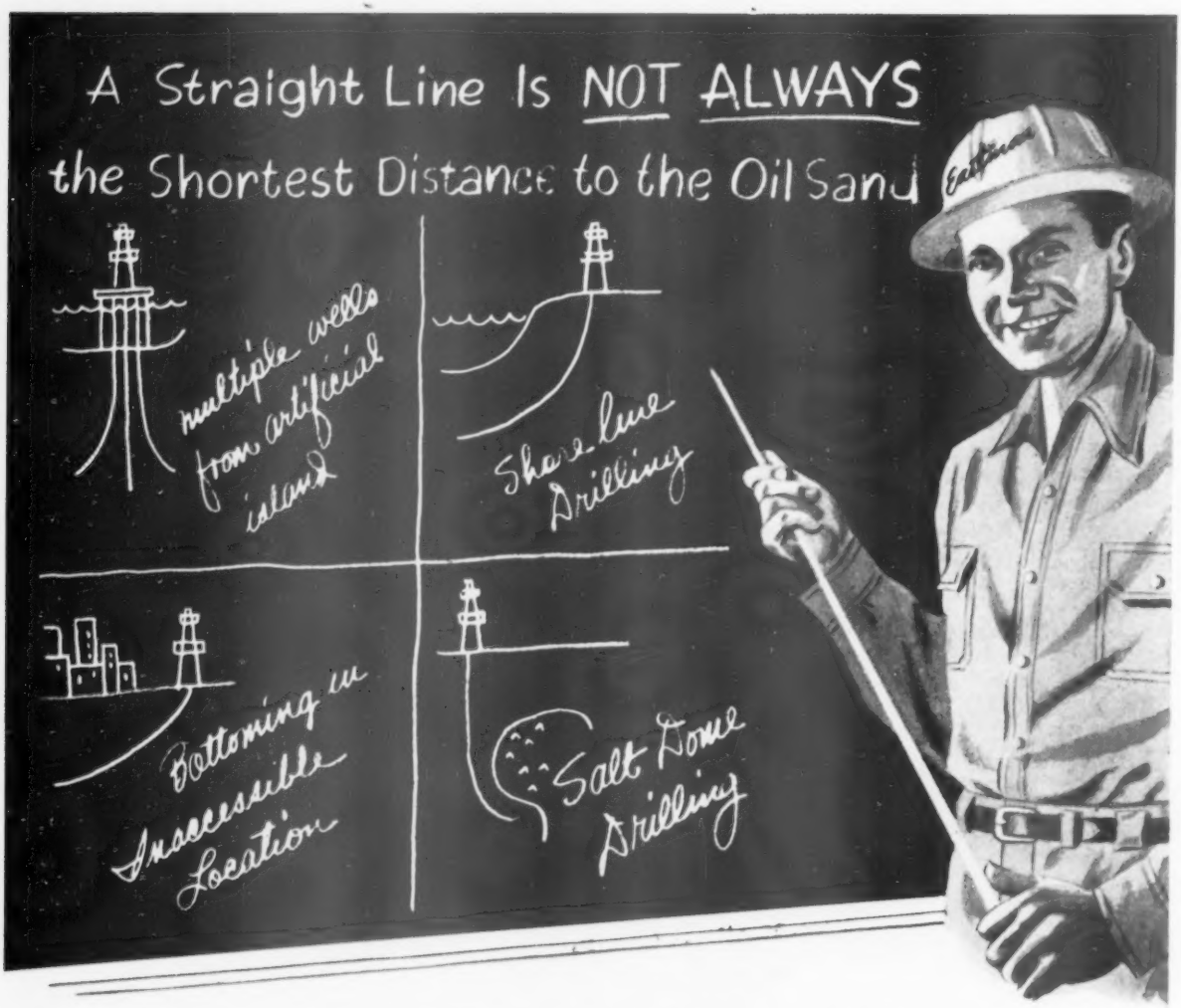
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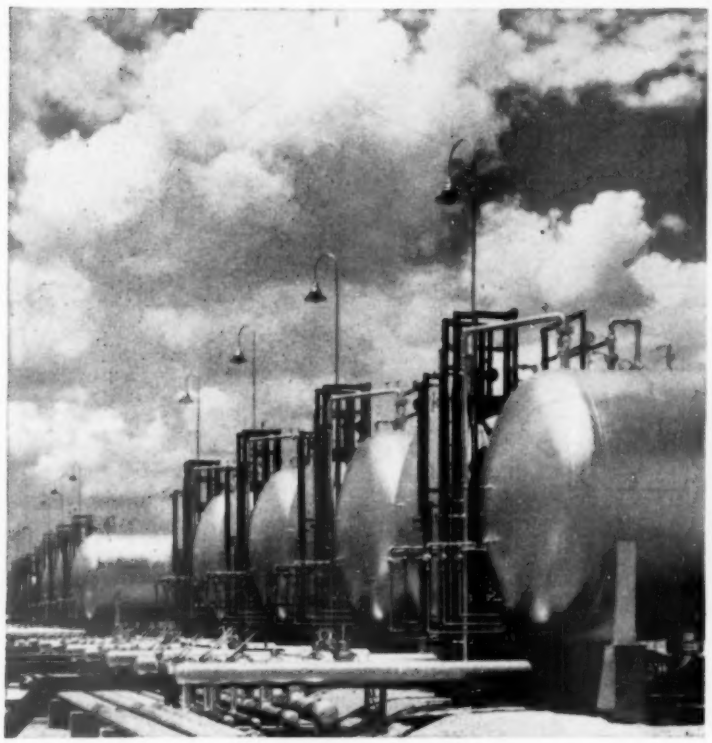

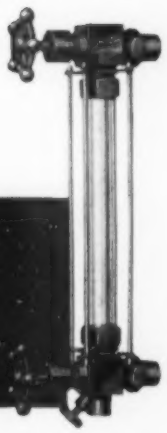

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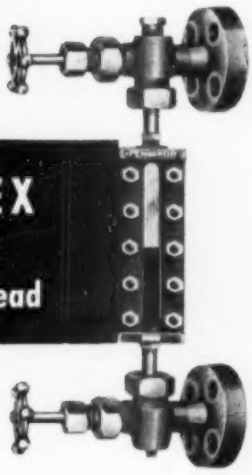
Meets Navy specifications



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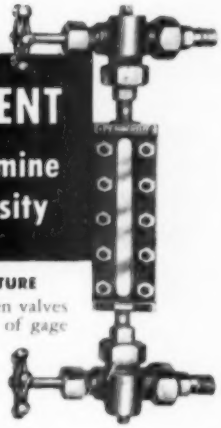

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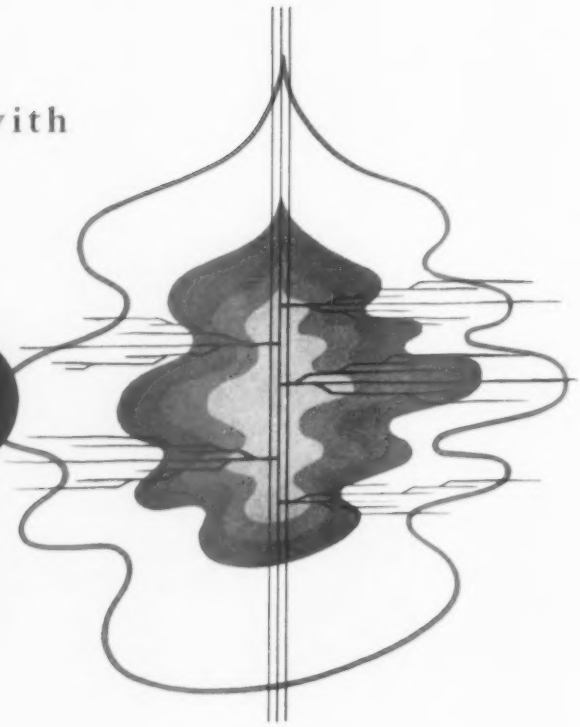
INCREASE PAY ZONE PERMEABILITY with

HALLIBURTON'S

MCA



Plugged up wells are being revived by a remarkable chemical called MCA. This Mud Cleanout Agent actually removes aqueous and bentonitic blocking materials from sand and limestone formations... actually increases permeability of the pay zone.

MCA, a unique compound of Halliburton's Morflo and hydrochloric acid, has a double punch that enables it to break water blocks, water-oil emulsions, and reduce water-swollen bentonite particles in the vicinity of the well bore.

Bentonitic materials, once a serious threat to free fluid flow, shrink before this exclusive Halliburton compound. Hydrogen from the hydrochloric acid replaces sodium on the bentonite. And MCA does not allow the bentonite particles to rehydrate even when the formation is filled with fresh water.

Results from MCA treatments have been highly encouraging. Now wells that might have been abandoned, and old pumping wells have been changed into economic producers. And many operators find that these treatments also are beneficial when used prior to squeeze cementing jobs.

Trained Halliburton specialists, with the big background of more than a million oil well service jobs, can assist you in determining when and where this effective compound can increase permeability in your pay zone. Just call your nearby Halliburton representative. Or contact Halliburton Oil Well Cementing Company, Duncan, Oklahoma.

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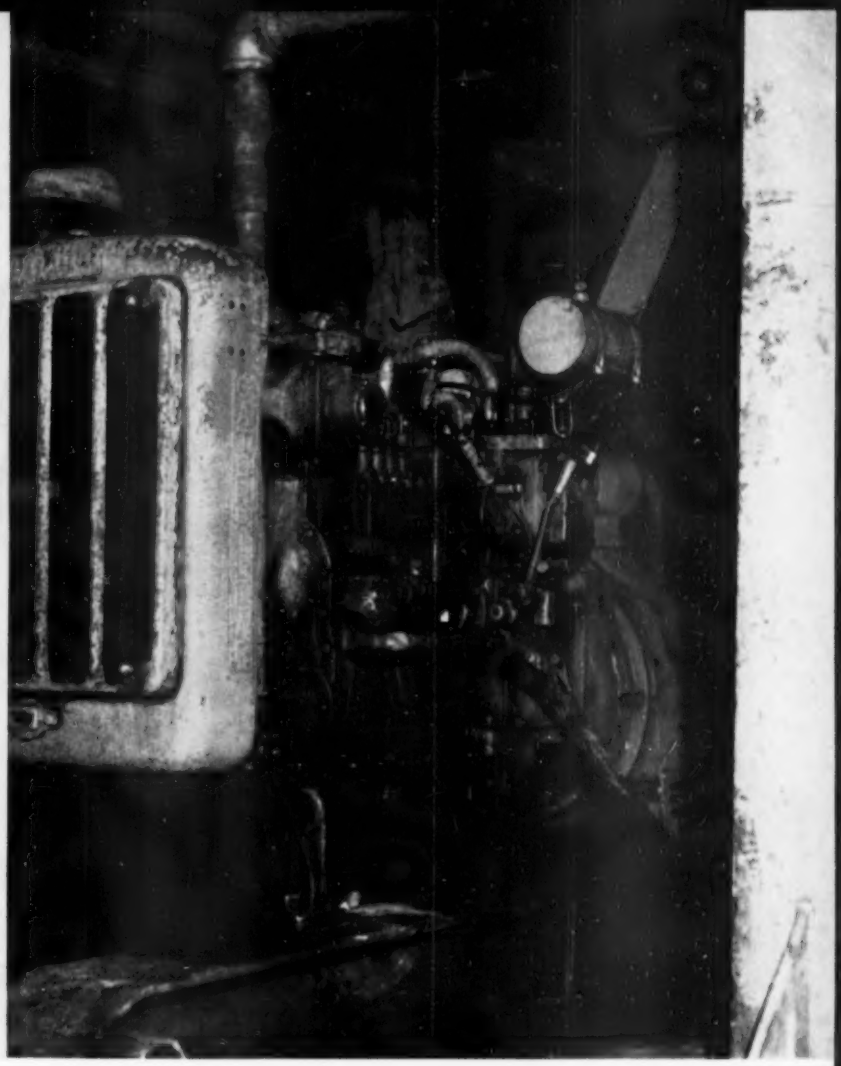

"Long life" and "dependability" take on real meaning for the Cat* Electric Set on this rig in Edmonton, Alberta. Particularly after you read the hour meter or listen to the comments of G. Williams, toolpusher for the owner, Commonwealth Drilling Co.

When the picture was taken the meter showed *20,797 hours* of steady, around-the-clock power produced by this Caterpillar Electric Set. And life has just begun. These big yellow diesels are capable of piling up 100 thousand hours and more!

"This Caterpillar Engine can't be beat for this kind of work and under these conditions," said Mr. Williams. "We're completely satisfied."

The D3400 provides power for rig lighting, water pump, shale shaker, electric heaters in the dog-house and substructure. The entire setup depends on this single engine, which has worked steadily through the years in Alberta's below-zero cold, and heat in excess of 96 degrees.

All Caterpillar Electric Sets—there are 12 sizes up to 315 KW—will deliver their full capacity continuously and under severe operating conditions. And they'll do it while burning inexpensive No. 2 furnace oil. In addition, crude oil fuel systems are available on most models.

In these inflationary days, you get real economy by standardizing on rugged Caterpillar Oilfield Engines. Operators and mechanics become familiar with one make. Parts inventory can be eliminated. And you get quick, reliable one-stop field service from *one* dealer—day or night, anywhere.

Call your dealer and let him show you proof of performance. And when you repower or buy new equipment, specify Caterpillar Oilfield Engines.

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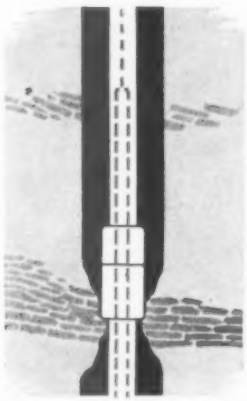
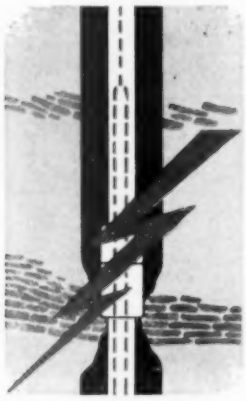
When you're stuck...

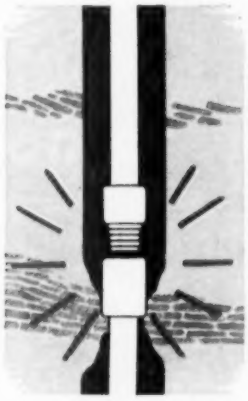
DIA-LOG's *unbeatable combination recovers drill pipe faster than any other method!*



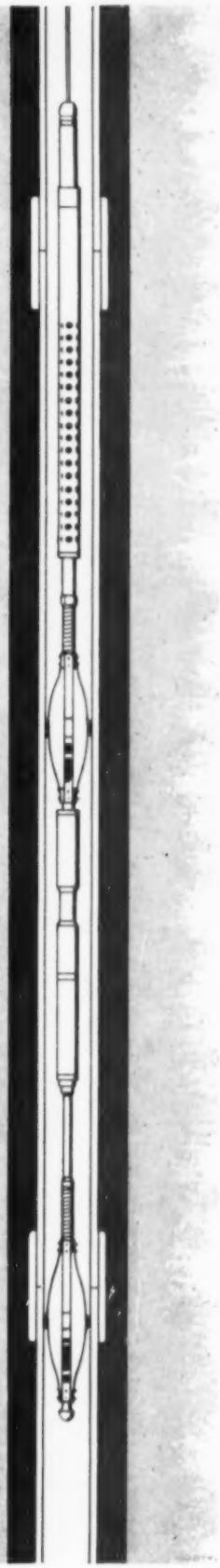
Free Point Indicator locates lowest depth where stretch and torque can be applied on the drill string.



The "String Shot" is lowered to the same depth on the same cable and detonated to loosen tool joint.



Back off recovers stuck drill pipe, drill collars, tubing or casing to permit further fishing operations.



THE DIA-LOG FREE POINT INDICATOR

This tool accurately determines the lowest depth where *both stretch and torque* can be applied to the drill string. It locates the exact point where stuck drill pipe, drill collars, tubing or casing can be freed. Movements as small as *one-thousandth of an inch* are recorded electronically on a surface indicating panel. Since reverse torque is used to back off, pipe to be recovered must be free in torque as well as stretch. *The Dia-Log Free Point Indicator gives you this correct depth in a matter of minutes!*

THE DIA-LOG STRING SHOT BACK-OFF

On the same electric conductor cable used for the Dia-Log Free Point Indicator, a "String Shot Back-Off" is run to the desired depth. Upon detonation, the "String Shot" delivers a sharp jar sufficient to start the unscrewing of the load-free joint. In thousands of successful runs, Dia-Log has recovered *millions* of feet of stuck pipe quickly and economically by employing this infallible combination. The "String Shot" also jars loose stuck tubing packers, frozen overshots, safety joints and stuck liners.

Wherever you are stuck -- Dia-Log Service is available

Dia-Log Service is available in all domestic oil fields. Wire, write or call any Dia-Log Company or Ford Alexander Corporation office for fast, dependable recovery of drill pipe.

OIL WELL ELECTRIC LINE SERVICES

Gulf Coast and Mid-Continent

THE DIA-LOG COMPANY

BOX 14103 — **HOUSTON, TEXAS**

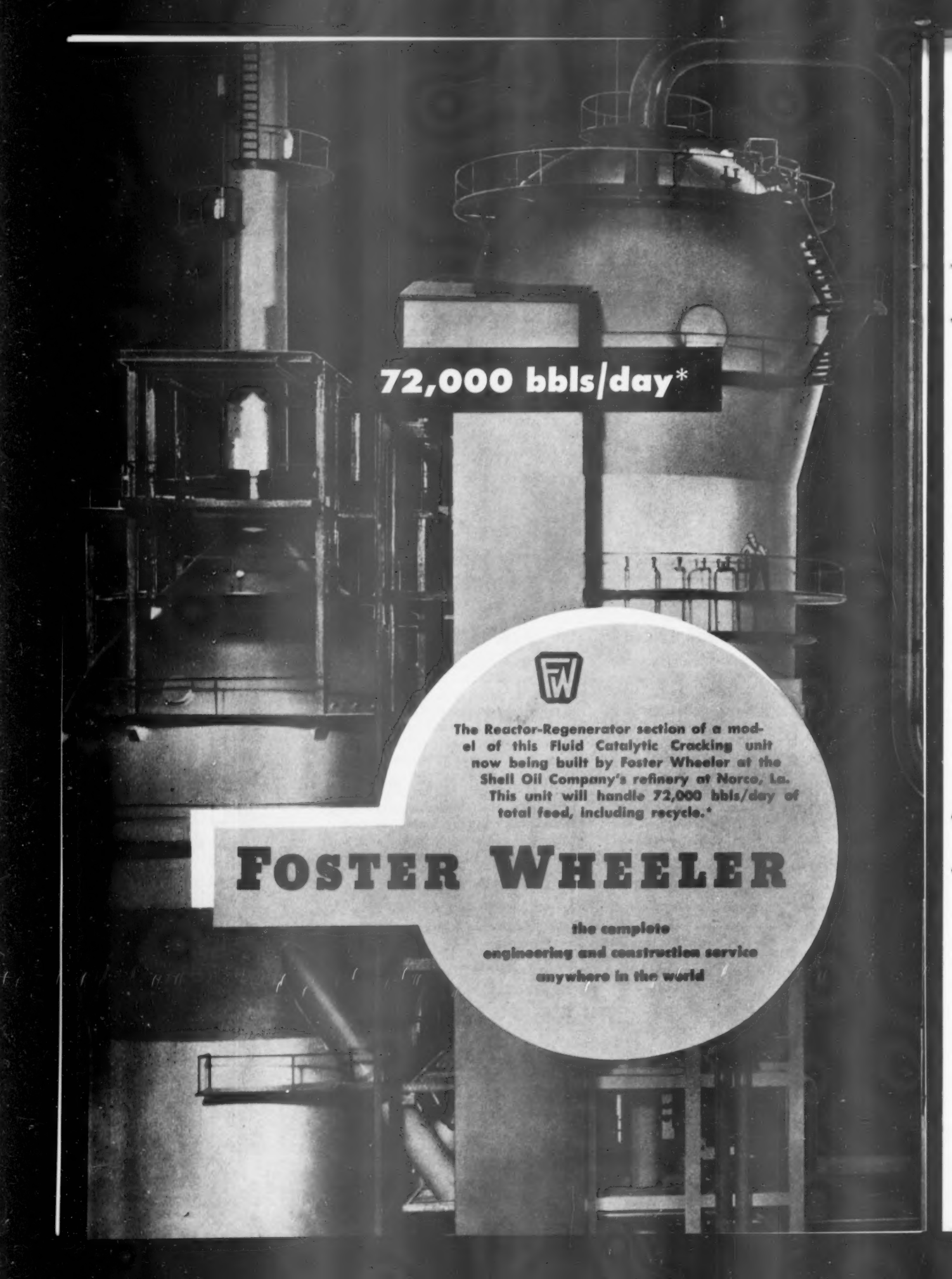
Odessa, Texas
Hobbs, New Mexico
Farmington, New Mexico
Oklahoma City, Oklahoma
Healdton, Oklahoma
Great Bend, Kansas
New Iberia, Louisiana
Houma, Louisiana
Natchez, Mississippi
El Dorado, Arkansas
Corpus Christi, Texas
Kilgore, Texas

California and Rocky Mountains

THE FORD ALEXANDER CORPORATION

BOX 800 — **WHITTIER, CALIFORNIA**

Ventura, California
Taft, California



The Reactor-Regenerator section of a model of this Fluid Catalytic Cracking unit now being built by Foster Wheeler at the Shell Oil Company's refinery at Norco, La. This unit will handle 72,000 bbls/day of total feed, including recycle.*

FOSTER WHEELER

the complete
engineering and construction service
anywhere in the world

THE *Hydrair* H-35

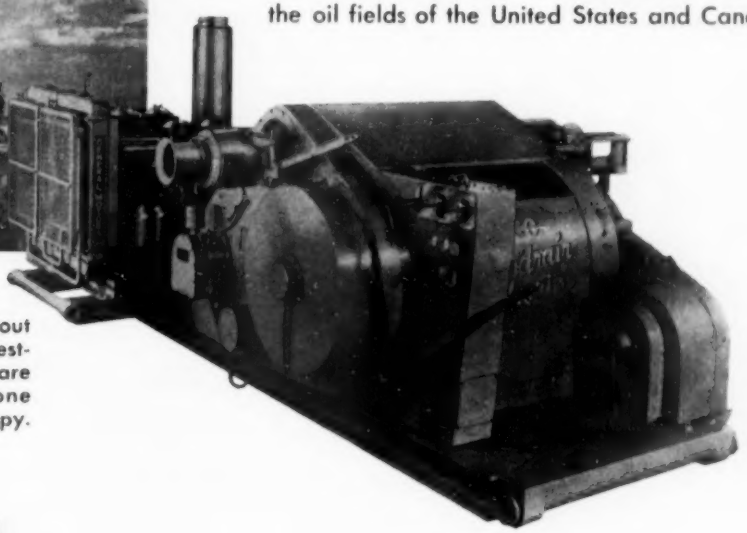
IDECO Quality — J&L Service

You get refinements in the H-35 Hydrair that you simply don't expect in the 350-horsepower class — refinements that make this IDECO rig a pleasure to own and a revelation to operate.

You can have the H-35 on skids, or as a complete trailer-mounted Rambler with Kwik-Lift Mast.

The rig is made in two basic designs, rated for drilling to 5,000′ with 4½″ drill stem, and for workover and servicing to depths as great as 16,400′.

Along with this and other examples of the world's most wanted drilling equipment, J&L offers you a new conception of really dependable IDECO parts service in the oil fields of the United States and Canada.



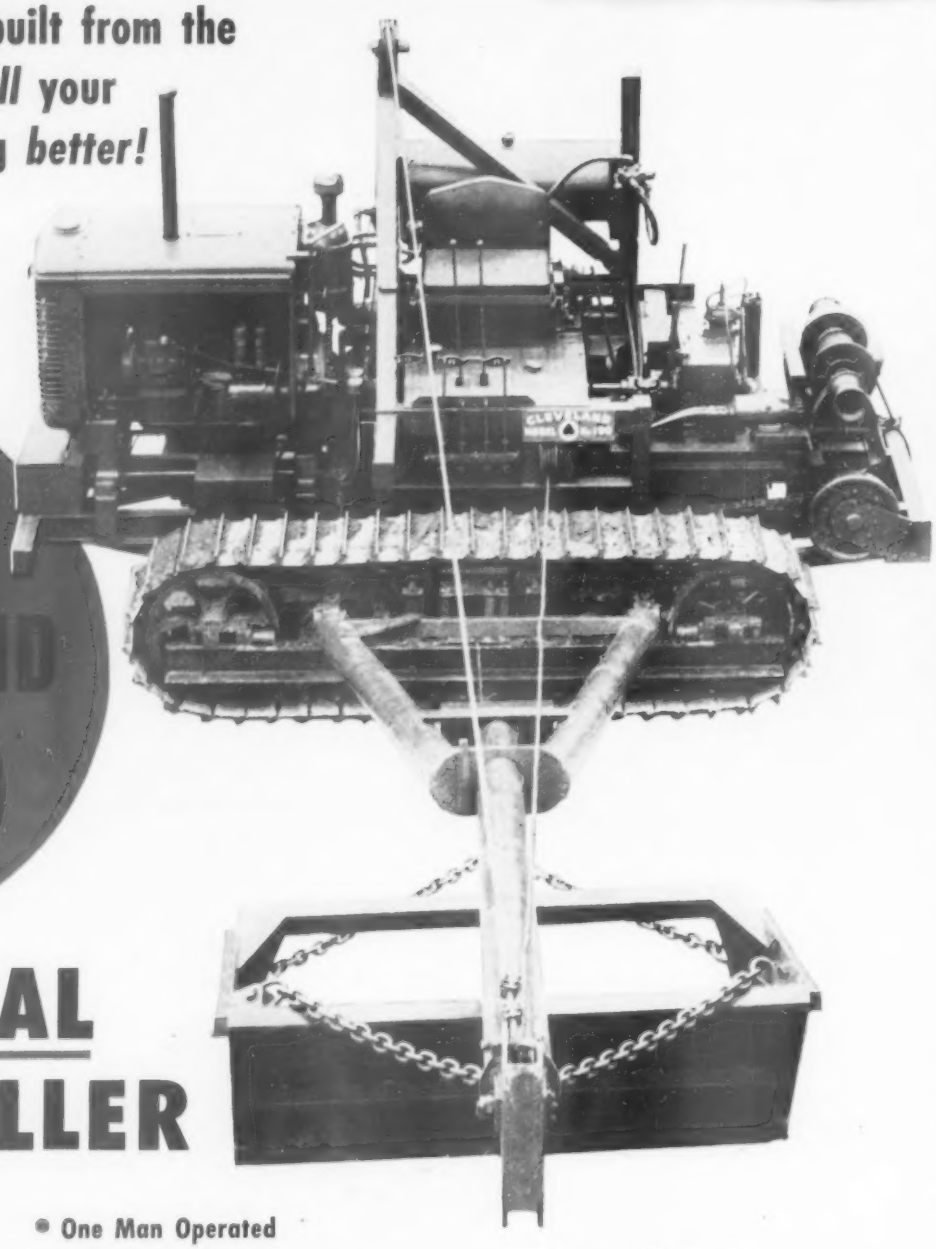
TO ANY DRILLER the facts about the H-35 Hydrair are as interesting as fiction, and the facts are all in BULLETIN-35-52. 'Phone any J&L number for your copy.

JONES & LAUGHLIN STEEL CORPORATION
SUPPLY DIVISION

Serving The United States and Canada
General Offices: TULSA, OKLAHOMA
J&L Tubular Products and Wire Rope

PESA
PARTNERS IN PETROLEUM PROGRESS

HERE IT IS . . . **built from the ground up to do *all* your pipeline backfilling *better!***



The CLEVELAND 190

A REAL BACKFILLER

Fast on the Flat
Sure in the Swamp
Steady in the Hills
Smooth on the Clean-up

- One Man Operated
- Perfect Balance, Side to Side, End to End
- 48 Crawler Speeds — from 1 Ft/M to 4.3 MPH
- Tow Winch Hydraulically Controlled
- 7-Ft. Backfill Board
- 4 Backfill Line Speeds
- Big Hydraulic Backfill Clutches
- Hydraulic Boom Hoist
- 79 HP, 467 cu. in. Diesel Engine

8' Over-all Width (Less Boom) • Weight 22,500 lbs. • 18" Pads
Ground Bearing Pressure 6.2 lbs. per sq. in.

GET THE FULL STORY ON THIS NEW CLEVELAND FROM YOUR LOCAL DISTRIBUTOR

THE CLEVELAND TRENCHER CO.
Pioneer of the Modern Trencher
20100 ST. CLAIR AVENUE • CLEVELAND 17, OHIO

New Chevrolet Trucks for '54

Loaded with brand-new advantages you need and want!

You'll get more work done in less time and at lower cost with new '54 Chevrolet trucks on the job. They bring you more new features . . . more big new advantages than any other truck on the road.

For example, you get new engine power in all models. The advanced "Thriftmaster 235" engine combines bigger displacement and higher compression with other new features to give you greater power and finer performance. The rugged "Loadmaster 235" engine offers increased strength and stamina for heavier trucking operations. The all-new "Jobmaster 261" engine* brings you extra reserves of high-compression power for hauling big loads on schedule.

In addition, you enjoy new and even greater operating economy. All three 1954 Chevrolet truck engines bring you the full benefit of thrifty high-compression power.

And there are many, many more new things you'll like about these great new Chevrolet trucks. New, roomier pickup and stake bodies let you haul more . . . save you time and extra trips. And they're set lower to the ground for easier loading and unloading. New truck Hydra-Matic transmission* lets you drive all day without shifting. It's offered not only on ½- and ¼-ton Chevrolet trucks, but on 1-ton models, too. New Comfortmaster cab with one-piece curved windshield and amazing new Ride Control Seat* offers the last word in comfort, convenience and safety.

Plan now to see your Chevrolet dealer and get all the facts about the new Chevrolet trucks for '54. . . . Chevrolet Division of General Motors, Detroit 2, Michigan.

Most trustworthy trucks on any job!

CHEVROLET

ADVANCE-DESIGN TRUCKS

CHEVROLET ADVANCE-DESIGN TRUCK FEATURES

THREE GREAT ENGINES—The new "Jobmaster 261" engine* for extra heavy hauling. The "Thriftmaster 235" or "Loadmaster 235" for light-, medium- and heavy-duty hauling. **NEW TRUCK HYDRA-MATIC TRANSMISSION***—offered on ½-, ¼- and 1-ton models. Heavy-Duty **SYNCHRO-MESH TRANSMISSION**—for fast, smooth shifting. **DIAPHRAGM SPRING CLUTCH**—improved-action engagement. **HYPOID REAR AXLE**—for longer life on all models. **TORQUE-ACTION BRAKES**—on all wheels on light- and medium-duty models. **TWIN-ACTION REAR WHEEL BRAKES**—on heavy-duty models. **DUAL-SHOE PARKING BRAKE**—greater holding ability on heavy-duty models. **NEW RIDE CONTROL SEAT*** eliminates backrubbing. **NEW, LARGER UNIT-DESIGNED PICKUP AND PLATFORM STAKE BODIES**—give increased load space. **COMFORTMASTER CAB**—offers greater comfort, convenience and safety. **PANORAMIC WINDSHIELD**—for increased driver vision. **WIDE-BASE WHEELS**—for increased tire mileage. **BALL-GEAR STEERING**—easier, safer handling. **ADVANCE-DESIGN STYLING**—rugged, handsome appearance.

**Optional at extra cost. Ride Control Seat is available on all cab models, "Jobmaster 261" engine on 2-ton models; truck Hydra-Matic transmission on ½-, ¼- and 1-ton models.*

MORE CHEVROLET TRUCKS IN USE THAN ANY OTHER MAKE!

OIC Valves

...THE MODERN LONG LINE

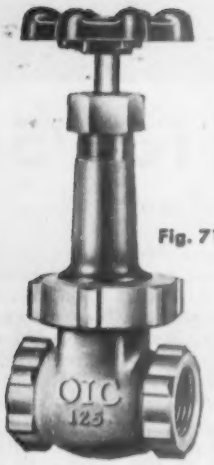


Fig. 7100

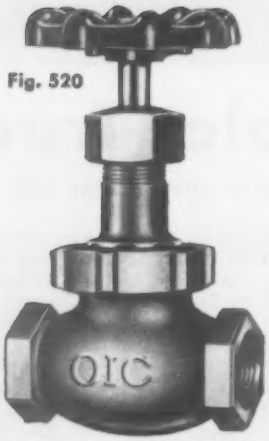


Fig. 520

BRONZE

⅛″ to 3″. 125, 150, 200, 300 and 350 WSP; 300A; 200, 400, 2,000 and 2,500 WOG.

Fig. 516

Fig. 333

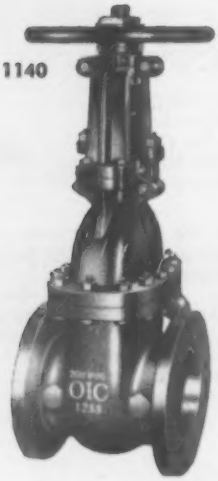


Fig. 1140

IRON

1¼″ to 16″. 125, 150 and 250 WSP; 175, 200, 400 and 500 WOG. ¼″ to 4″ DUO-BOLT Gates.

Fig. 124

CAST STEEL

2″ to 16″. 150, 300 and 600 lb. primary pressure series.

Fig. 6033

Fig. 3002

Fig. 1572

FORGED STEEL

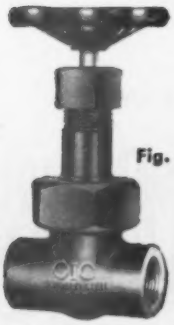


Fig. 1021

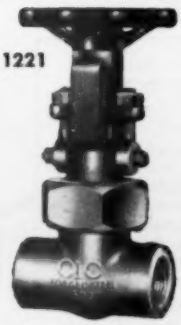


Fig. 1221

¼″ to 2″ Gate, Globe, Angle, Check Valves; 600 lb. primary pressure series.

STAINLESS STEEL

Fig. 810

½″ to 2″. Gate valves, 200 lb. primary pressure series.

Fig. 815

LUBRICATED PLUG

Fig. 10

1″ to 24″. Iron . . . 175 psi to 800 psi working pressures. Cast Steel series 150 lb.-230 psi, 300 lb.-600 psi and ASA 150 lb. class.

Contact your authorized OIC Distributor

OIC
FOUNDED 1883

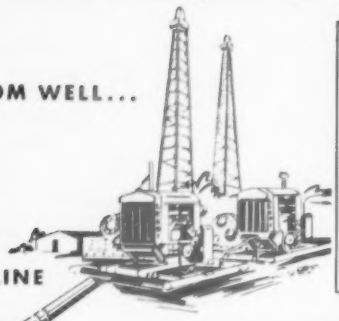
Write for the OIC Catalog Digest for quick valve selection.

THE OHIO INJECTOR COMPANY

WADSWORTH, OHIO

YOUNG *All the Way!*

FROM WELL...

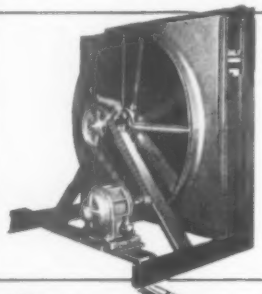


...TO GASOLINE PLANT

"MONO-WELD" Heavy-Duty Steel Radiator

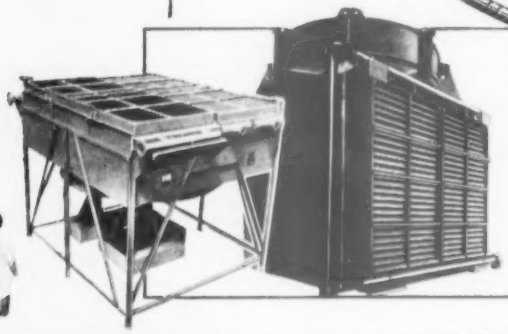
Fixed and Removable Tube and Bundle Heat Exchangers

"MONO-WELD" Radiators are available for cooling jacket water or for cooling jacket water and lube oil in a single unit. They are especially suitable for skid-mounted equipment and have welded steel tank and side member construction. Tube and bundle heat exchangers are particularly well adapted to applications where compactness is at a premium.



Heavy-Duty "FULL FLOW" and Standard Series Jacket Water Coolers

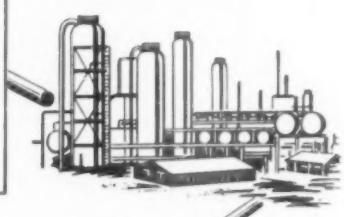
Remote locations require dependable, trouble-free cooling units, easy to maintain. Sturdily constructed "FULL FLOW" Jacket Water Coolers with removable sections (optional) make it possible to repair and replace easily. Accessories: motors, idlers, pumps, surge tanks, controls, shutters, etc.



Young "HC" (left) and "VAD" Vertical Air Discharge Cooling and Condensing Equipment

These large units can take care of your biggest cooling job. Versatility is a keynote—standard models provide for water, gas or oil cooling, steam or vapor condensing in any combination. Accessories available: motors, controls, shutters, gear boxes, etc.

...TO REFINERY



Young Radiators For All Automotive Applications

Young serves every phase of the oil industry. Many manufacturers of oil transport and delivery equipment specify Young Radiators for gasoline and Diesel equipment. These radiators are carefully engineered for the specific job, as is the heat transfer equipment for the biggest oil field jobs.

...TO CONSUMER

YOUNG RADIATOR COMPANY

Dept. 204-B, Racine, Wisconsin
Plants at Racine, Wisconsin and Mattoon, Illinois

YOUNG

Heat Transfer Products for Automotive, Agricultural, Industrial, Gas and Diesel Engine Applications

Heating, Cooling, Air Conditioning Products for Home and Industry

Leaders in Heat Transfer Engineering for more than 25 years

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FLOURNOY & EVERETT, INC., 5043 Santa Fe Ave., Los Angeles.
HAROLD J. YOUNG, 206 Montgomery Bldg., Muskegon.
JONES & LAUGHLIN STEEL CORP., Supply Div., 106 Main St., Bradford, Penn.; Union Commerce Bldg., Cleveland; 401 Liberty St., Gateway Center, Pittsburgh; Clarksburg, West Virginia.

Other Representatives in Principal Cities

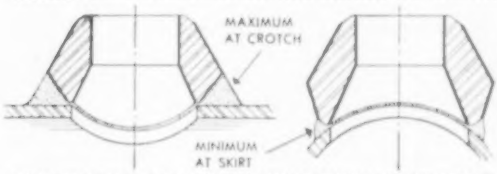
See the Yellow Pages of Your Phone Book

WELDOLET WELDING FITTINGS
MEAN PERMANENT PIPING
... PERMANENT SAVINGS

Here's Why >

Every fitting is shaped to fit the pipe and is self-aligning.

The template is the inside of the fitting. The hole in the run-pipe can be cut out either before or after the fitting is installed.



Welded as indicated—to fill in 50° bevel at crotch, blending into 35° bevel at skirt—full reinforcement is accomplished.

The outlet is machine-beveled for quick, easy butt-welding of the branch pipe—shop or field fabrication.

Here's How >

1. The WeldOlet is raised off the run pipe to establish proper weld gap, as required by Code for all types of branch connections. This is accomplished by placing spacers, e.g. welding rods, under the fitting.
2. The base joint is tack welded, preferably at four points, each half way between the crotch and skirt sections of the fitting. The spacers are then removed.
3. The stringer bead—or beads—is applied completely around the base of the fitting. The established weld gap assures full penetration.
4. Additional passes are applied as necessary to fill in the tapered base bevel of the fitting. The intermediate passes should not be continuous. Re-inforcing welds should be made at the crotch bevel area at each side of the fitting only. A continuous cover bead should be added, filling the bevel at the base of the fitting at the crotch and skirt sections.

TO COMPLETELY SAFEGUARD AGAINST:

- high pressures
- high temperatures
- internal corrosion
- external stresses

TO PROVIDE:

- improved fluid flow
- trouble-free and permanent piping systems

TO ACCOMPLISH ALL THESE THINGS IN THE MOST ECONOMICAL MANNER . . . SPECIFY AND USE

BONNEY WELDOLET WELDING FITTINGS

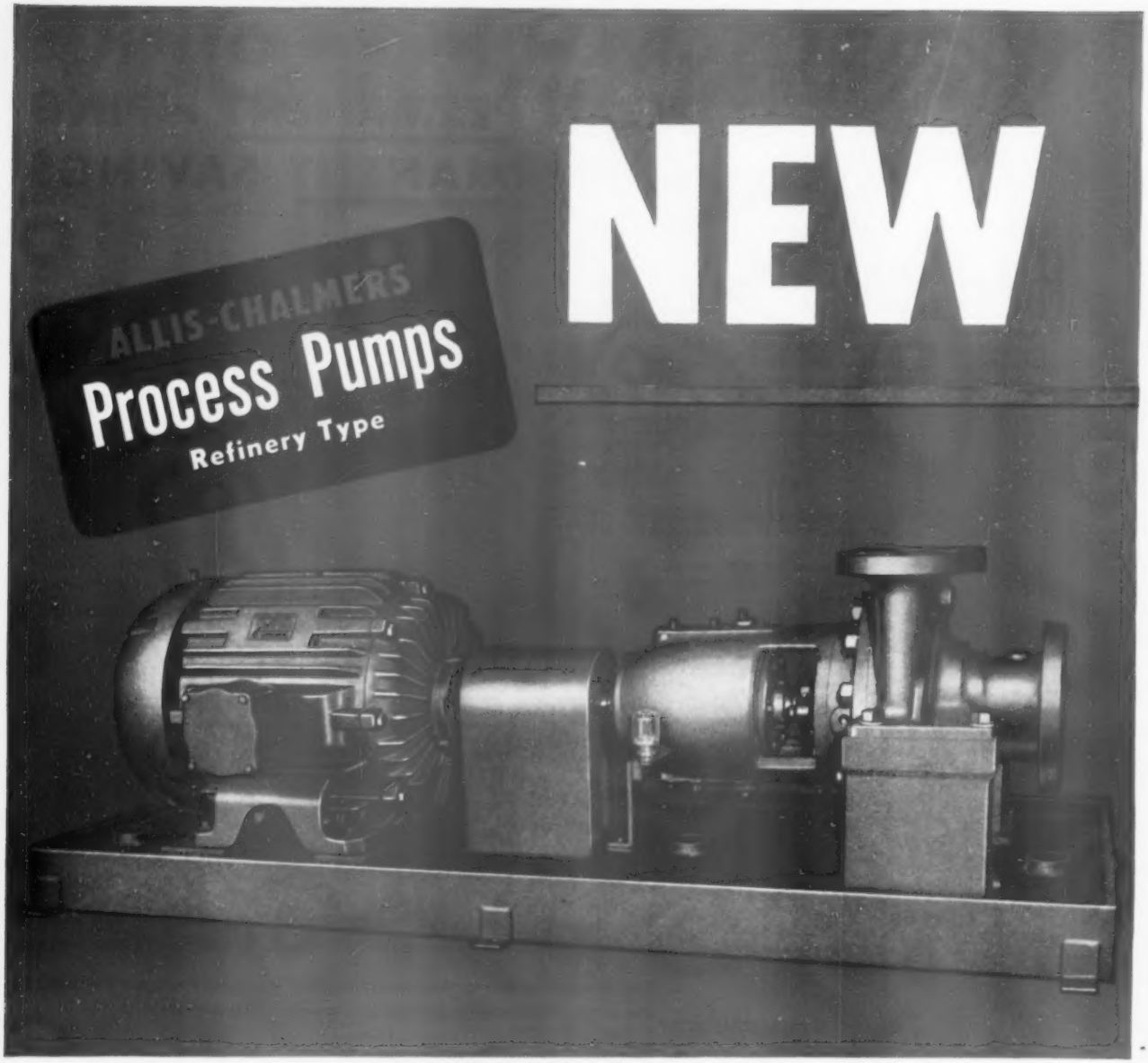
DISTRIBUTORS IN PRINCIPAL CITIES

FOR COMPLETE ENGINEERING DATA WRITE FOR YOUR BONNEY W-3 WELDOLET CATALOG.

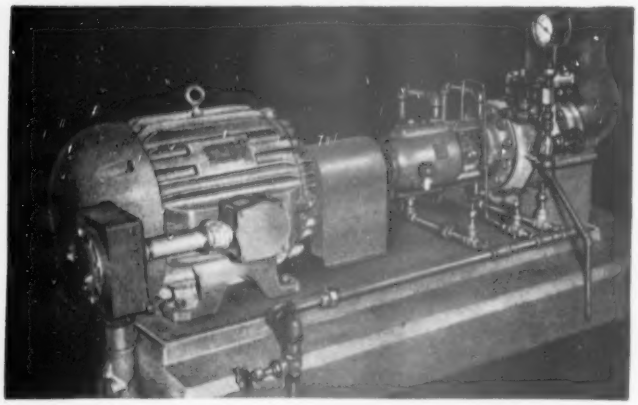
WELDING FITTINGS DIVISION

BONNEY FORGE & TOOL WORKS

ENG. DEPT., 366 GREEN STREET
ALLENTOWN, PENNSYLVANIA



Easy Installation and Maintenance



All Allis-Chalmers Type R pumps are furnished with spacer-type couplings. This type of coupling permits the pump to be disconnected from the driver and the entire rotating element — bearing bracket, shaft and impeller — removed without disturbing either the piping or the driver. This type of assembly permits quick examination of the pump, simplifies repairs or replacements and keeps downtime of the unit to a minimum.

In addition, two sets of bearing bracket assemblies fit the complete range of pump sizes. Since parts for only two sizes of bearing brackets are required, regardless of the number of pumps operated, parts inventories are greatly reduced. All bearing bracket parts of R-9 pumps are interchangeable and all R-12s are interchangeable. Where continuous operation is vital, a complete spare assembly can be kept on hand and replaced very quickly.

Refinery Pump

- ☆ **Specially designed for high temperature operation**
- ☆ **Choice of materials and stuffing box arrangements**
- ☆ **Ample provision for cooling**

HERE IS AN ENTIRELY NEW refinery-type pump. It has every feature designed for continuous trouble-free service and to keep your process pumping costs low.

Sealing Arrangement

When the standard stuffing box is used, it carries an adequate amount of packing plus a seal cage. A mechanical seal is interchangeable with the packing. No machining required. A seal plus auxiliary stuffing box may be installed by simply cutting off the end of the standard stuffing box.

Cooling Methods

The stuffing box is cooled by a water jacket of ample capacity. Further cooling of the packing is provided by in-and-out connections for the sealing oil, which is thus able to act as a coolant as well as a sealing medium. The stuffing box is provided with a water-flushed smothering gland. A second water jacket surrounds the front bearing and the lower part of the oil reservoir. For extremely high temperature operation, a water-cooled pedestal can be supplied.

Throat Bushing

A renewable throat bushing is tack-welded on the pump side of the stuffing box. The close clearance between the bushing and the shaft sleeve cuts infiltration into the stuffing box to a minimum. In case of seal or packing failure, the bushing remains in position and will not blow out.

Wearing Rings

The impeller and casing are both provided with front and rear wearing rings which make it easy and economical to maintain proper clearance. This design also reduces side thrust which in turn reduces shaft deflection and wear.

Double Volute

Double volute design is used in pumps of more than 400 gpm capacity. Forces set up in one volute are counteracted by equal and opposite forces in the other volute. Deflection forces are greatly reduced.

The impeller has low NPSH requirement so that it will successfully handle high volatile liquids at high temperatures.

Centerline Mounting

The pump is mounted at the centerline of the casing. Pipe strains are transmitted directly to the foundation. When proper precautions are taken, alignment of rotating parts will not be affected.

Complete Pumping Unit

Allis-Chalmers can supply a complete pumping unit — pump, motor and control — assembled and ready to install. Coordinated design and manufacture assure undivided responsibility. Call your nearby Allis-Chalmers District Office for help on your next pumping problem. Or write for Bulletin 52B7775. Allis-Chalmers, Milwaukee 1, Wis.

A-4031

ALLIS-CHALMERS

ELIMINATE SHOCK ON DRILL STEM TESTS

JOHNSTON HYDRAULIC TESTER

Lets You "CRACK THAT VALVE" on Bottom

● Just as above ground you "crack the valve" to ease pressure release, the Johnston Hydraulic Tester eases the pressure change during drill stem tests. Opening in stages during two to four minutes eliminates shock to formation, pipe and instruments.

● Less water cushion is required; damage to hole wall is lessened. More positive interpretation of test zone productivity is possible. The drill pipe weight opens the Tester; removing the weight closes it.

● "Crack that Valve" and not the formation by using the Johnston Hydraulic Tester.

FORMATION AND CASING TESTING
JOHNSTON

JOHNSTON TESTERS INC.

HOUSTON • LOS ANGELES

Export Division: 3035 Andrita St., Los Angeles 65, California

SERVICE BRANCHES IN ALL ACTIVE AREAS

NOW...

THE 6000# HANCOCK STAINLESS STEEL

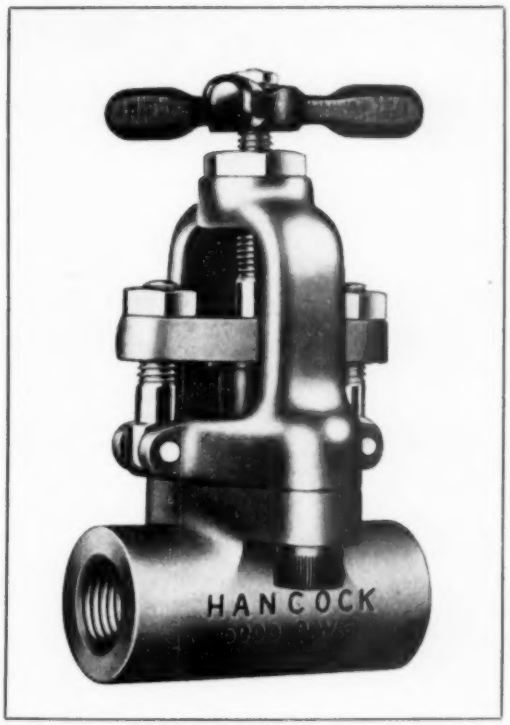
INSTRUMENT VALVE

A new HIGH PRESSURE valve for use on

INSTRUMENT PANELS	BY-PASS LINES
INSTRUMENT LINES	CORROSIVE LINES
GAUGE LINES	ORIFICE METERS

This heavy-duty Hancock Instrument Valve was specially engineered for these and similar services where high temperatures are of short duration and occur infrequently. It is small, easy to handle—weighs only 2¼ lbs. Space-saving compactness permits close alignment of piping with near structures. The packing gland can be readily pulled tight in close quarters. Disassembly is no problem in tight spots. Every practical use of stainless steel assures maximum protection against corrosion. You can be sure of long-life service and economical maintenance.

YOUR INDUSTRIAL SUPPLY DISTRIBUTOR has the 6000# Hancock Instrument Valve. He is as close as your telephone. Call him for complete specification and operational data. You can count on fast delivery to meet your requirements.



SPECIFICATION DATA

SERVICE RATING: 6000# O.W.G.—100° F.
TYPES: Globe and angle.
SIZES: ¼", ⅜" and ½".
CONNECTIONS: Screwed and socket weld ends.
BODY: Type 410 forged stainless steel with integral stuffing box.
YOKE: Forged carbon steel—bolted to body with two hollow head alloy steel cap screws removable with Allen-type wrench. **No bonnet joint**—no gasket to leak or blow.
STEM: 300 Brinell stainless steel with bronze stem thread bushing.
STEM-DISC: Needle point design.
SEAT: Type 410 stainless steel. Integral with the body.
PACKING GLAND: Forged steel. Packing gland bolts, nuts, pins and packing stop rings—stainless steel.
PACKING: Highest quality long fiber asbestos, graphited and corrosion inhibited.
HANDLE: Malleable iron. Three-prong type for easy operation. Handle nut—steel.
MARKER PLATE: Stainless steel.

1877 HANCOCK U S A

When Hancocks go in, valve costs go down

HANCOCK VALVES

A product of **MANNING, MAXWELL & MOORE, INC.** Watertown 72, Massachusetts

MAKERS OF 'HANCOCK' VALVES, 'ASHCROFT' GAUGES, 'AMERICAN' INDUSTRIAL INSTRUMENTS, 'CONSOLIDATED' SAFETY AND RELIEF VALVES, AIRCRAFT PRODUCTS. BUILDERS OF "SHAW-BOX" AND 'LOAD LIFTER' CRANES, 'BUDGIT' AND 'LOAD LIFTER' HOISTS AND OTHER LIFTING SPECIALTIES.

How ESSO STANDARD OIL CO. Speeds Materials Handling

Side-loading Traveloader Sets New Standards for Speed and Efficiency

Esso Standard Oil Company uses three model T10-G2 Traveloaders continuously in their materials storage yard at Baton Rouge, Louisiana. The Baton Rouge yard has a high turnover of materials including pipes, rails, lumber and many other hard-to-handle items of equipment. Three men each operating Traveloaders can move, stack, and deliver this material with a minimum of assistance from others. This is typical of what Traveloader is accomplishing for hundreds of satisfied users and of what it can do for you. Traveloader operates in a straight line, parallel to its load, in aisles no wider than 10′ thereby increasing the storage capacity of a given area up to 50%.

A Wide Variety of Attachments gives Traveloader versatility, flexibility and utility beyond the range of any other materials handling equipment. Traveloader can be used to replace a yard crane, strip steel carrier, multiple pallet mover, fork lift truck and transporter.

Baker
industrial trucks

Write today and let us send you Bulletin AD-30A containing full details and specifications on this remarkable machine.

THE BAKER-RAULANG COMPANY
1247 WEST 80th STREET • CLEVELAND 2, OHIO

The Baker-Lull Corporation • Subsidiary, Minneapolis, Minn.
Material Handling and Construction Equipment

AEROQUIP SELF-SEALING COUPLINGS

AND FLEXIBLE HOSE LINES

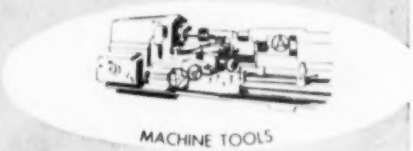
Speed Maintenance

WHEREVER FLUID-CARRYING LINES MUST BE DISCONNECTED AND RECONNECTED

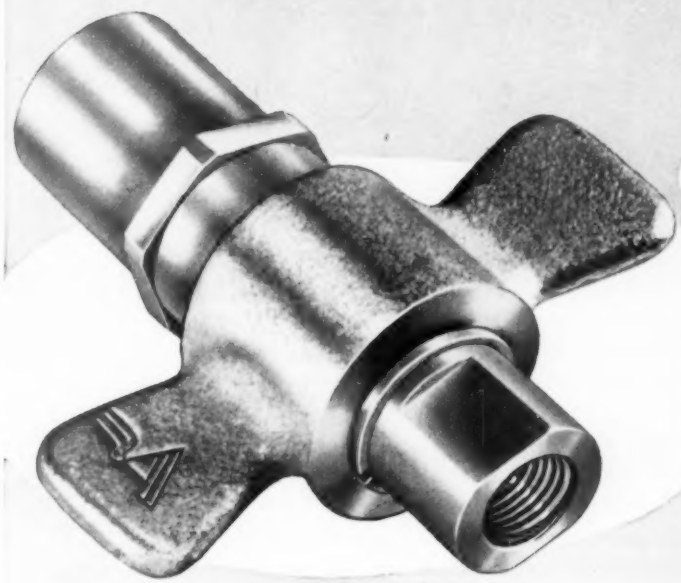
BUSES AND TRUCKS

RAILROADS

OIL FIELD DRILLING RIGS


MACHINE TOOLS

MATERIALS HANDLING TRUCKS



***Speed* maintenance, *speed* repair operations and *speed* interchanging of accessories joined by fluid-carrying lines with Aeroquip Self-Sealing Couplings. Lines may be separated in a few seconds without loss of fluid. No air enters the system upon reconnection. There is no need to drain or prime the fluid system. One Self-Sealing Coupling takes the place of two shut-off valves.**

Aeroquip

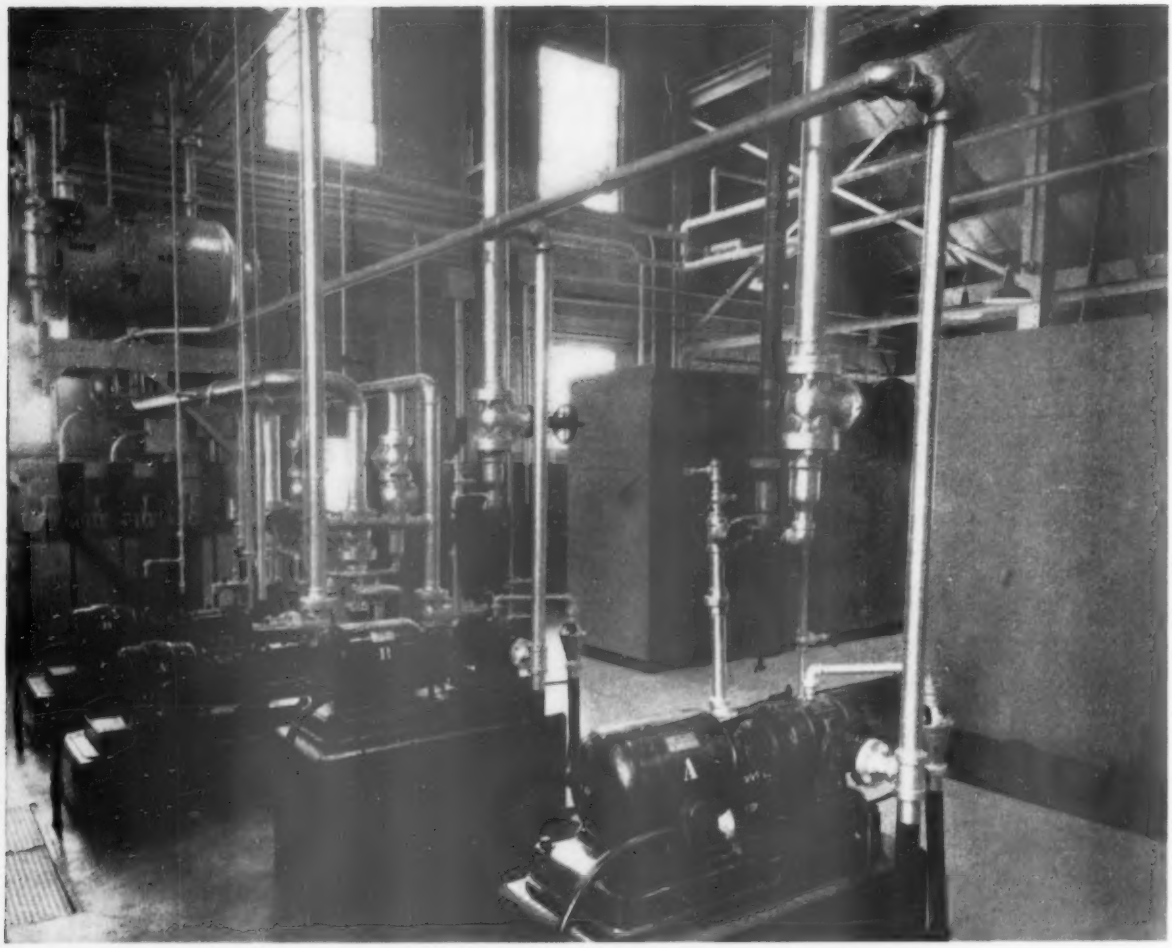
REG. TRADE MARK

AEROQUIP CORPORATION, JACKSON, MICHIGAN

SALES OFFICES: Burbank, Calif. • Dayton, Ohio • Hagerstown, Md. • High Point, N. C. • Miami Springs, Fla. • Minneapolis, Minn. • Portland, Ore. • Wichita, Kan.

IN CANADA: Preco Progress and Engineering Corporation Ltd., Toronto
IN ENGLAND: Super Oil Seals & Gaskets, Ltd., Birmingham

AEROQUIP PRODUCTS ARE FULLY PROTECTED BY PATENTS IN U.S.A. AND ABROAD



Two V-12 Vacuum Pumps, 1750 r.p.m., rated 47 c.f.m. referred to 24-inch vacuum intake, handling non-condensibles from turbo-generators at 5000 ft. elevation.

another

Fuller ROTARY VACUUM PUMP INSTALLATION

Those who use Fuller Rotaries for gas-gathering and boosting service also find other applications for them.

In the Elk Basin Unit Pressure Maintenance Plant, operated by Stanolind Oil and Gas Company in Park county, Wyoming, Fuller Rotary Compressors are used to supply pulsation-free air for plant services. Other Fuller Rotaries, as illustrated above, handle non-condensibles from turbo-generators.

Fuller Rotary Compressors serve in every industry where reliable, economical, low-maintenance operation is important in capacities to 3300 c.f.m. and pressures up to 125-lb. per square inch. Write today for complete information. Fuller Company, Catasauqua, Pennsylvania.

Fuller... high efficiency, vane-type rotary compressors for gas gathering, gas boosting, repressuring flare gas, refrigeration, engine starting, pneumatic power, pneumatic controls, general plant air, air lifts, and vacuum service.

C-242
2248

PIPE LINE PROGRESS

30-inch A.O.Smith line pipe being cradled into position in a New Mexico spread of El Paso Natural Gas Company project.

New El Paso Natural Gas line absorbs more than 300 MILES OF 30-INCH A. O. SMITH LINE PIPE

Essential additional gas volume for California, Arizona, New Mexico and west Texas is now being provided through construction of new pipe line facilities by El Paso Natural Gas Company.

More than 300 miles of high-strength, 30-inch, thin-wall, internally expanded line pipe were furnished by us for this project which was completed in January, 1954.

El Paso Natural Gas Company's new line will carry gas from the Permian Basin of southeastern New Mexico and west Texas, and from the San Juan Basin of northwestern New Mexico and southwestern Colorado across New Mexico and Arizona to the Colorado River on the California border.

The 30-inch pipe line was started during July, 1953, and will be put into service the first part of 1954 . . . another pipe line conquest of rough terrain, desert, mountains and canyons.

A. O. Smith Line Pipe is available in a complete range of sizes and wall thicknesses, from 8⅝-in. to 36-in. diameters.

The A.O. Smith Casing Mill is operating at capacity to supply vitally needed casing for the Oil and Gas Industry.

DEPENDABILITY through RESEARCH and ENGINEERING

A.O. Smith CORPORATION

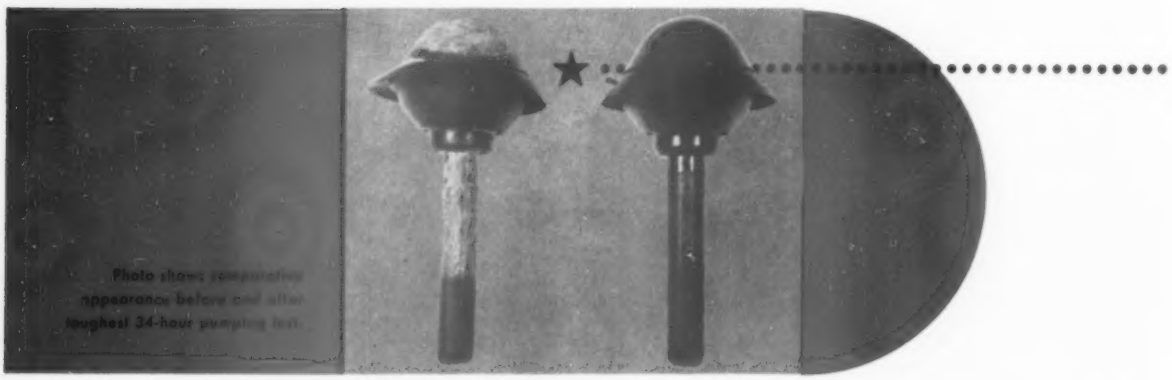
LINE PIPE • CASING

Chicago 4 • Dallas 2 • Denver 2 • Houston 2 • Los Angeles 22
Midland 5, Texas • New Orleans 12 • New York 17 • Pittsburgh 19
San Francisco 4 • Seattle 1 • Tulsa 3 • Washington 6, D.C.
International Division: Milwaukee 1

now...after 12 years' development

HALLIBURTON'S IMPORTANT NEW SUPER SEAL FLOAT EQUIPMENT

Leakproof and Wear-Resistant Like No Other—
Provides Fluid-Tight Seal Under Toughest Conditions!



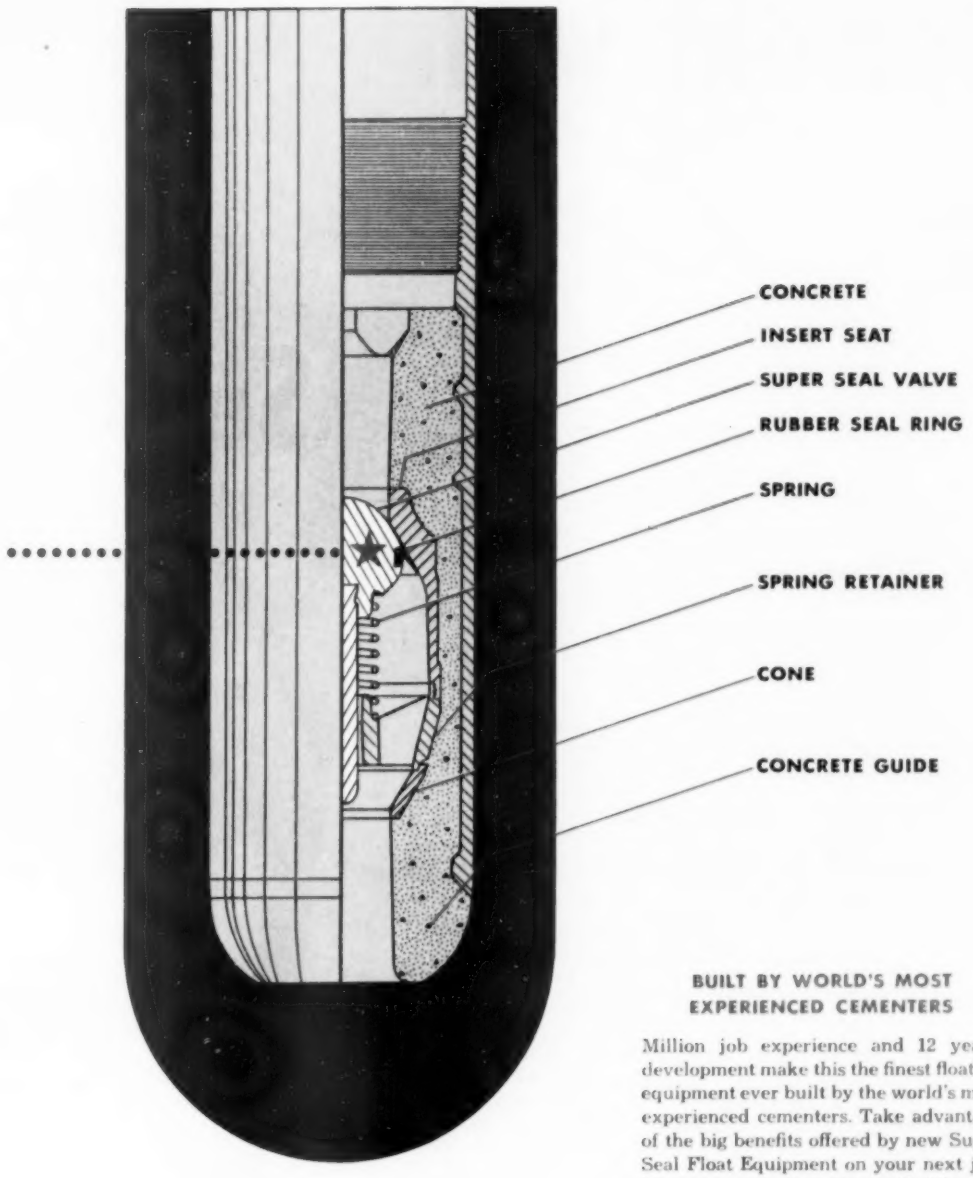
Fine equipment takes time to improve. Halliburton's floating equipment was the finest available. *But Halliburton . . . never satisfied . . . spent 12 years developing the remarkable new Super Seal Float Equipment.*

SUPER SEAL PROVIDES THESE POSITIVE ADVANTAGES:

- ★ **Greater protection against drilling fluid contaminating cement.**
- ★ **Extra fluid-tightness holds cement outside casing like no other.**
- ★ **Improved design floats casing to bottom safer than before.**

here's why:

- New design using rubber ring seals super-tight.
- Super Seal Valve tests higher because it makes conical band contact on seat, which eliminates concentrated loading and greater wear of line contact.
- Offers increased resistance to downhole stress . . . phenolic impact molding compound gives valve assembly higher compressive strength.
- Provides durability under extreme temperatures . . . 4" valve stronger than any casing now in use up to 400° F.
- Special shock resistant concrete locks assembly solidly . . . attains compressive strength of 9000 to 11,990 p.s.i. — and easily drilled out.
- Handles great volumes under high pumping speeds . . . yet provides swift, positive back-pressure shut-off.
- New concrete guide design adds increased strength and improved downhole landing efficiency.



BUILT BY WORLD'S MOST EXPERIENCED CEMENTERS

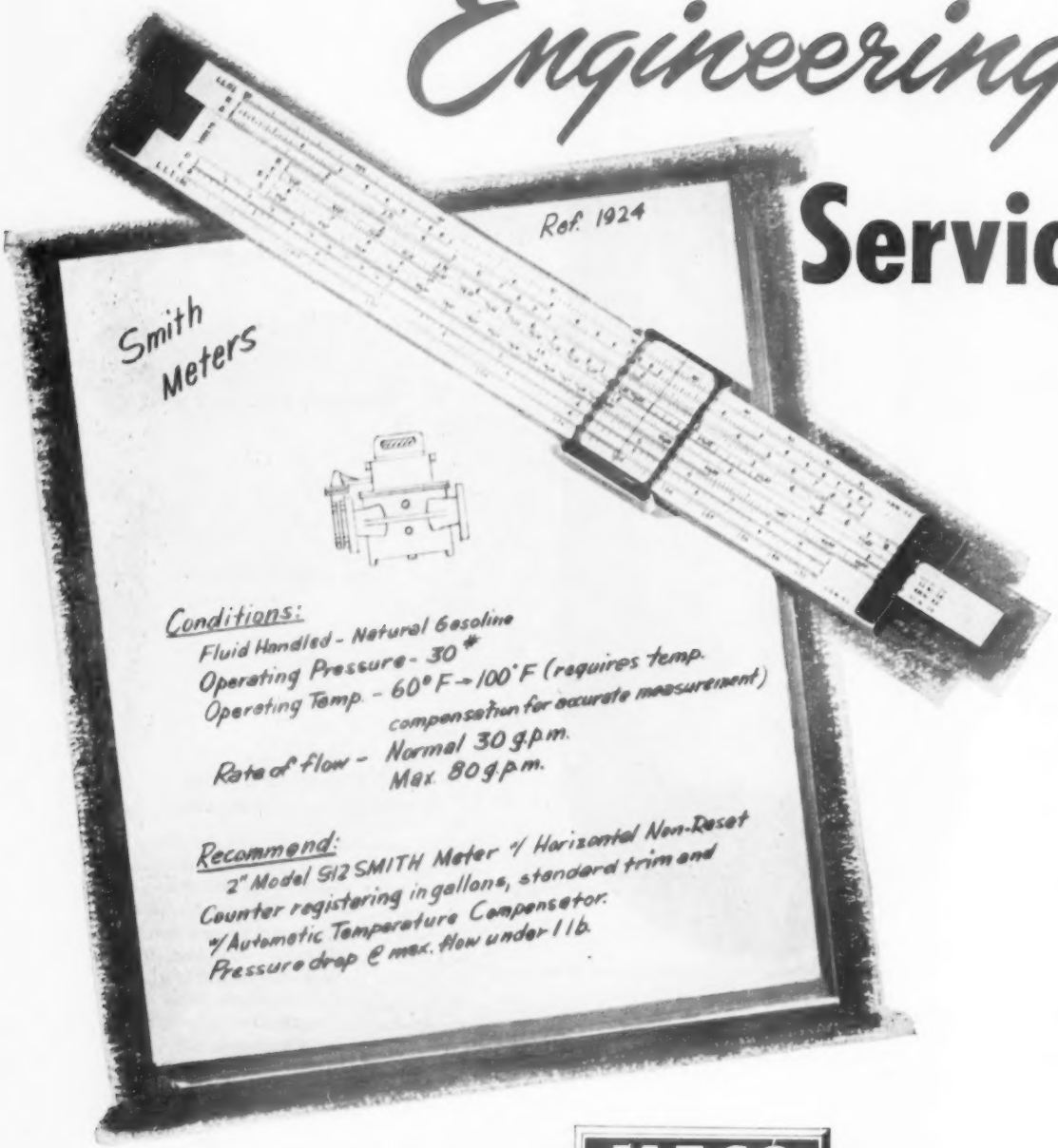
Million job experience and 12 years' development make this the finest floating equipment ever built by the world's most experienced cementers. Take advantage of the big benefits offered by new Super Seal Float Equipment on your next job. Phone your local or district Halliburton office for additional information. Or contact Halliburton Oil Well Cementing Company, Duncan, Oklahoma.

HALLIBURTON

CEMENTING EQUIPMENT

PERPETUAL PROGRESS IN OIL WELL CEMENTING!

Equipment with *Engineering* Service


Ref. 1924
Smith Meters
Conditions:
Fluid Handled - Natural Gasoline
Operating Pressure - 30 #
Operating Temp. - 60° F → 100° F (requires temp. compensation for accurate measurement)
Rate of flow - Normal 30 g.p.m.
Max. 80 g.p.m.
Recommend:
2" Model 512 SMITH Meter w/ Horizontal Non-Reset Counter registering in gallons, standard trim and w/ Automatic Temperature Compensator.
Pressure drop @ max. flow under 1 lb.

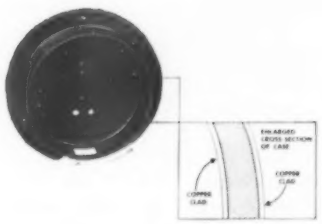
MECO

MAINTENANCE *Engineering* **CORPORATION**

P. O. BOX 2637

3711 CLINTON DRIVE
HOUSTON, TEXAS

You're looking at the biggest pressure gauge development since the "Recalibrator"



Another first for Marsh

Here is a case in keeping with the "Conoweld" tube. Another recent Marsh development, it is called the

New *Marshalloy* Case

It is a copper-clad wrought steel case of boiler plate thickness, four times as strong, and one-third lighter than conventional cast iron cases. Copper surface makes it as non-corrosive as a plastic or die-cast case. Handsome, corrosion-resistant, satin black enamel and Marsh safety blow-out plug are the finishing touches.

Here is one of those typically MARSH developments . . . the kind of pioneering step you have come to expect from the organization that originated the basic advances in pressure gauges culminating in the exclusive "Recalibrator." This latest Marsh development is known as the

NEW MARSH *"Conoweld"* TUBE

This time we have made the best part of the best Marsh gauge still better. We have gone into the part that actually does the work — the socket and tube — and have made it permanently leak-tight from inlet to tip of tube.

We have done this by fusing the tube into the socket and the tip to the tube so that the whole assembly is truly *one piece*. The photo of one of the sockets sawed in half shows the perfect fusion of the vital joint. Tests and photomicrographs prove the perfection of the fusion.

Developing the fusing process called for extensive research. The method as finally perfected — the "Conoweld" process — involves first fusing the tube to the socket and end-piece; then tempering the tube to required resiliency.

Yes, it is these dramatic departures from beaten paths that have achieved leadership for Marsh gauges and are ever increasing that leadership. Ask for latest information covering gauges for all services.

MARSH INSTRUMENT CO. *Sales affiliate of Jas. P. Marsh Corporation* **Dept. L, Skokie, Ill.**

HOUSTON BRANCH PLANT: 1121 Rothwell St., Sect. 15, Houston, Texas

MARSH GAUGES

"THE STANDARD OF ACCURACY"

MANUFACTURERS OF THERMOMETERS • WATER REGULATING VALVES • SOLENOID VALVES • HEATING SPECIALTIES

consider:

Corrosion Resistance and Analyses

As chromium and nickel provide corrosion resistance in stainless steel, it follows that 18-8, 18-8 Cb, 18-8 ELC and 18-8 Ti, having similar chromium and nickel content, should have the same corrosion resistance. Exposure in certain types of service, however, may prove otherwise.

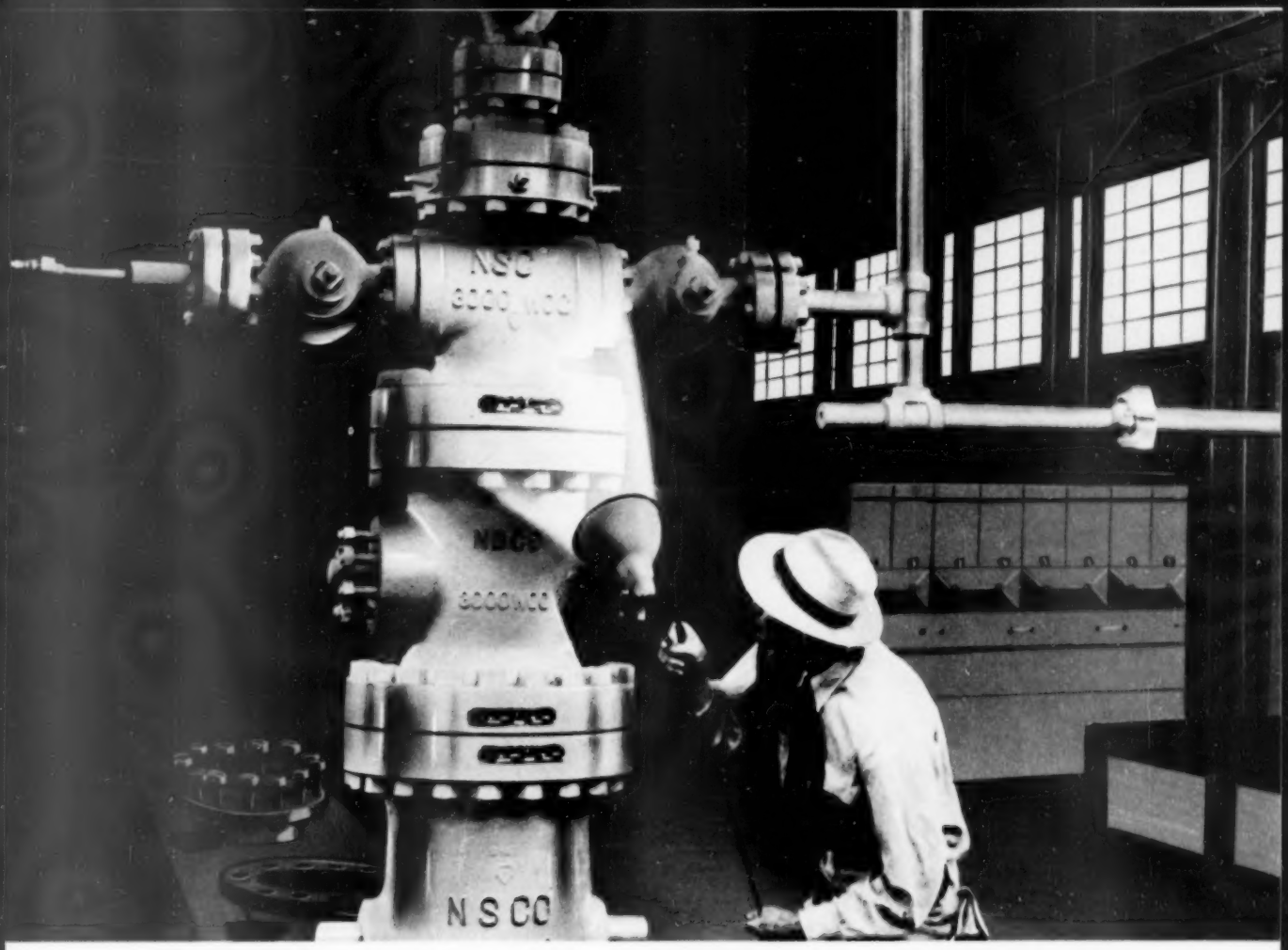
If tubing of these materials is field welded without subsequent heat treatment, or operated intermittently at high temperatures, there will be a difference in corrosion resistance. The 18-8 grade may lose its corrosion resistant properties while the other three grades maintain theirs. This is because of slight differences in chemistry—5 parts in 10,000 in carbon content or the addition of 5 to 7 parts in 1,000 of columbium or titanium. Thus, your particular end use service condition, in addition to the basic cost of materials, should dictate which grade to use.

For virtually any application—pressure or mechanical—B&W can provide either seamless or welded stainless tubing in any number of grades, in a broad size range. Help in obtaining the best stainless tubing for your applications is available through B&W Regional Sales Offices and a nationwide network of experienced tubing distributors. Mr. Tubes—your link to B&W—will be pleased to furnish detailed answers to your stainless tubing problems.

THE BABCOCK & WILCOX COMPANY
TUBULAR PRODUCTS DIVISION
Beaver Falls, Pa.—Seamless Tubing; Welded Stainless Steel Tubing
Alliance, Ohio—Welded Carbon Steel Tubing

B&W SEAMLESS and WELDED TUBES

TA-1812(SWP)



Ultra-violet light checks the quality!

We go through some unusual test procedures at our Houston plant to make sure that National Wellhead equipment lives up to its reputation for safe, most dependable performance.

Wellhead assemblies before shipment are filled with a special test fluid—a fluid that contains an agent to make it "wetter water," which would seep through any tiny flaws that might occur in the assembly structure. To this fluid, we also add a fluorescent dye that glows bright green when exposed to ultra-violet light.

The assembly is then hydraulically tested with pressures that are 10% higher than industry standards. To really prove the quality of the assembly, full test pressure is pumped into the assembly and quickly exhausted *at least three times.*

In the final stage, this pressure is held during an exhaustive inspection where ultra-violet light is carefully played over the entire assembly. The absence of green stains under this detecting light proves the assembly "qualified" for dependable service under the National Blue label.

You will find constant testing for assured quality behind every drilling or production product manufactured at the National Supply plants . . . *to make sure that you get the best for your equipment dollar.*

First in quality...
First in supply service
in oil country everywhere

NATIONAL BLUE PRODUCTS

THE
NATIONAL SUPPLY
COMPANY
PITTSBURGH 30, PENNSYLVANIA

Designed and rated to pump the well dry...

NATIONAL
pumping units

Here's why your best buys for profitable pumping are in the complete line of National Pumping Units:

Each model, individually engineered to provide long service life under specific loads, is the result of National Supply's continuing research and development program—plus decades of "know-how" in oil field equipment manufacturing. Each National Pumper is:

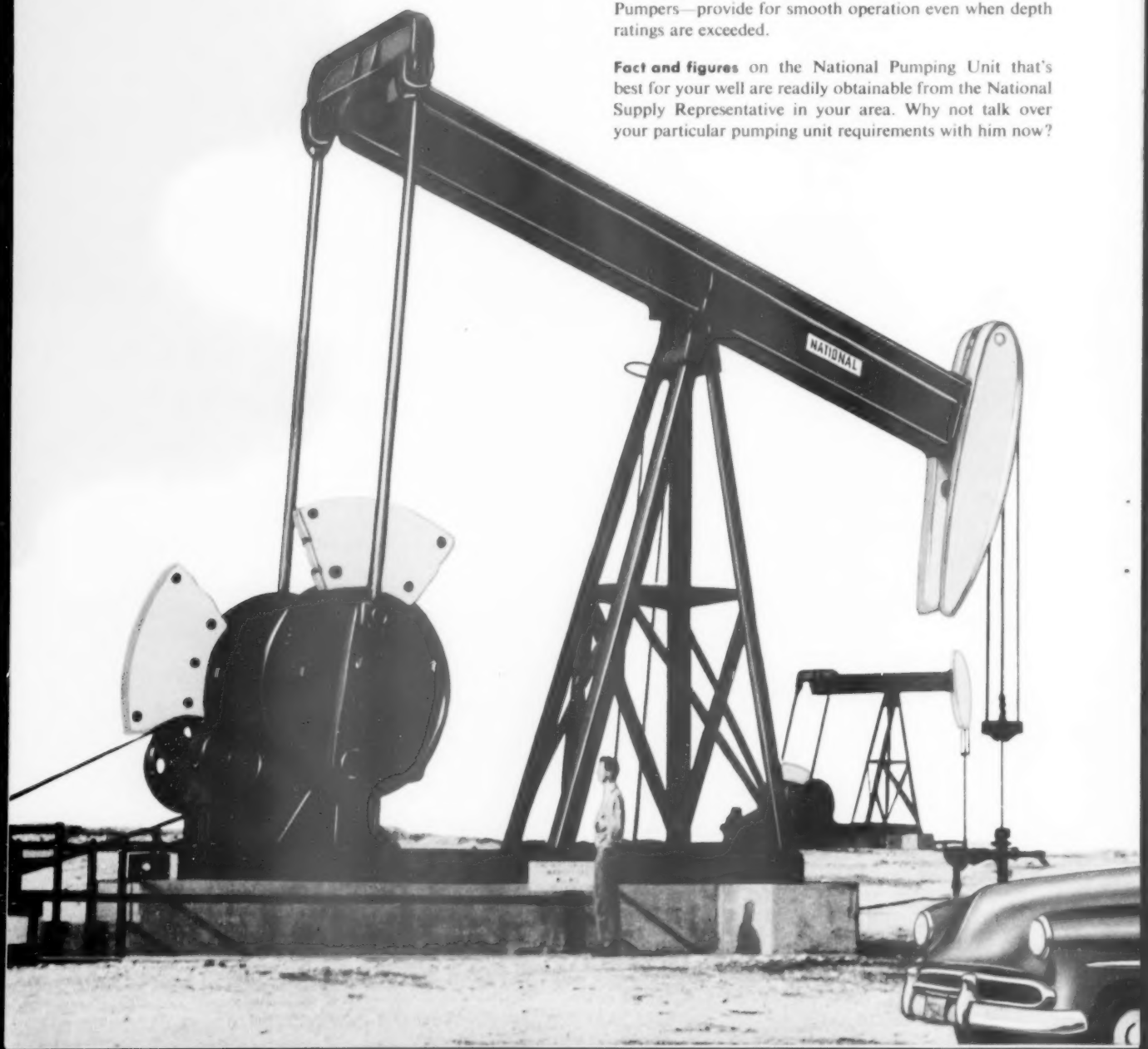
RUGGEDLY BUILT—heavy-duty frame with welded construction at all extreme stress points;

SAFETY ENGINEERED—counterweights designed for easy, safe adjustment;

EXCEPTIONALLY LONG-LIVED—precision-made for less wear, longer service under all operating conditions;

CONSERVATIVELY RATED—extra stamina and capacity—the two well-known bonus values built into all National Pumpers—provide for smooth operation even when depth ratings are exceeded.

Fact and figures on the National Pumping Unit that's best for your well are readily obtainable from the National Supply Representative in your area. Why not talk over your particular pumping unit requirements with him now?



A model for every Job...

National's line of Pumping Units is so complete that there is a model to economically suit every pumping job . . . Ranging from a 3200 pound API rated walking beam unit to a 32,400 pound API rated walking beam model—National Pumping Units are available in *38 standard combinations*, in beam or crank counterweighted types.

First in quality...
First in supply service
in oil country everywhere

NATIONAL BLUE PRODUCTS

THE NATIONAL SUPPLY COMPANY
PITTSBURGH 30, PENNSYLVANIA

DIVISION OFFICES: Denver/Ft. Worth, Houston, Pittsburgh, Tulsa, Torrance

CANADA: The National Supply Company, Ltd., 200 F. W. Clark Building, 709 Eighth Avenue, West, Calgary, Alberta

EXPORT: 600 Fifth Avenue, New York 20, N. Y., U. S. A., River Plate House, 12 South Place, London E. C. 2

for more information
on PROFITABLE production
see the next page

NATIONAL OIL FIELD MACHINERY AND EQUIPMENT
SPANG STEEL PIPE • SUPERIOR & ATLAS ENGINES

...and here's the rest of the family of

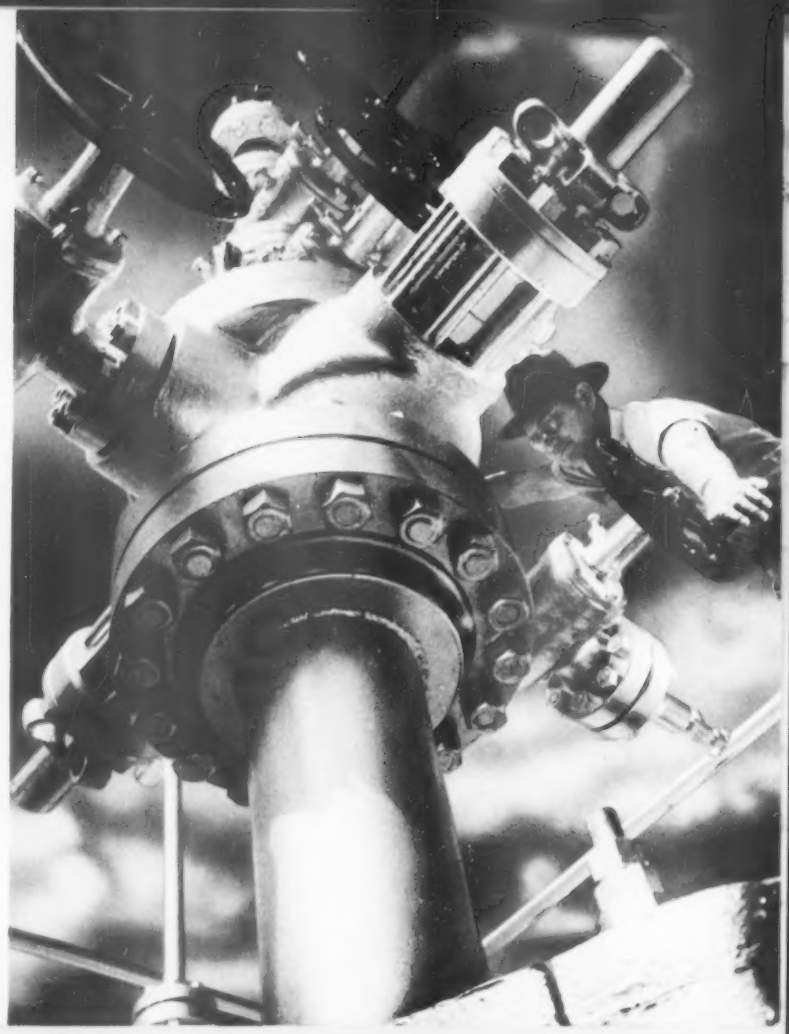
NATIONAL PRODUCTION EQUIPMENT

for profitable recovery by any method

Backed by the same research and precision-manufacturing methods which produce National Pumping Units, every unit in this family of production equipment is designed for trouble-free, profitable recovery.

Regardless of the recovery methods you employ, you'll find it worthwhile to get *all* the facts on this complete line of National Production Equipment for primary and secondary operations. The National Supply Store nearest you will be glad to furnish product bulletins and any other information you may require.

National Wellhead Equipment, available for practically any completion method at any depth or working pressure in all sizes and types.



National's new F-90 Triplex Pump for water flooding, salt water disposal, oil gathering or as a power-oil source for subsurface hydraulic pumping.

National's Plunger Lift uses formation pressure for efficiently producing wells where reservoir conditions are suitable.

National's Sucker Rods, produced in various grades under the most exacting standards in the industry to suit virtually all well conditions.

First in quality...
First in supply service
in oil country everywhere

NATIONAL BLUE PRODUCTS

NATIONAL OIL FIELD MACHINERY AND EQUIPMENT
SPANG STEEL PIPE • SUPERIOR & ATLAS ENGINES

THE NATIONAL SUPPLY COMPANY

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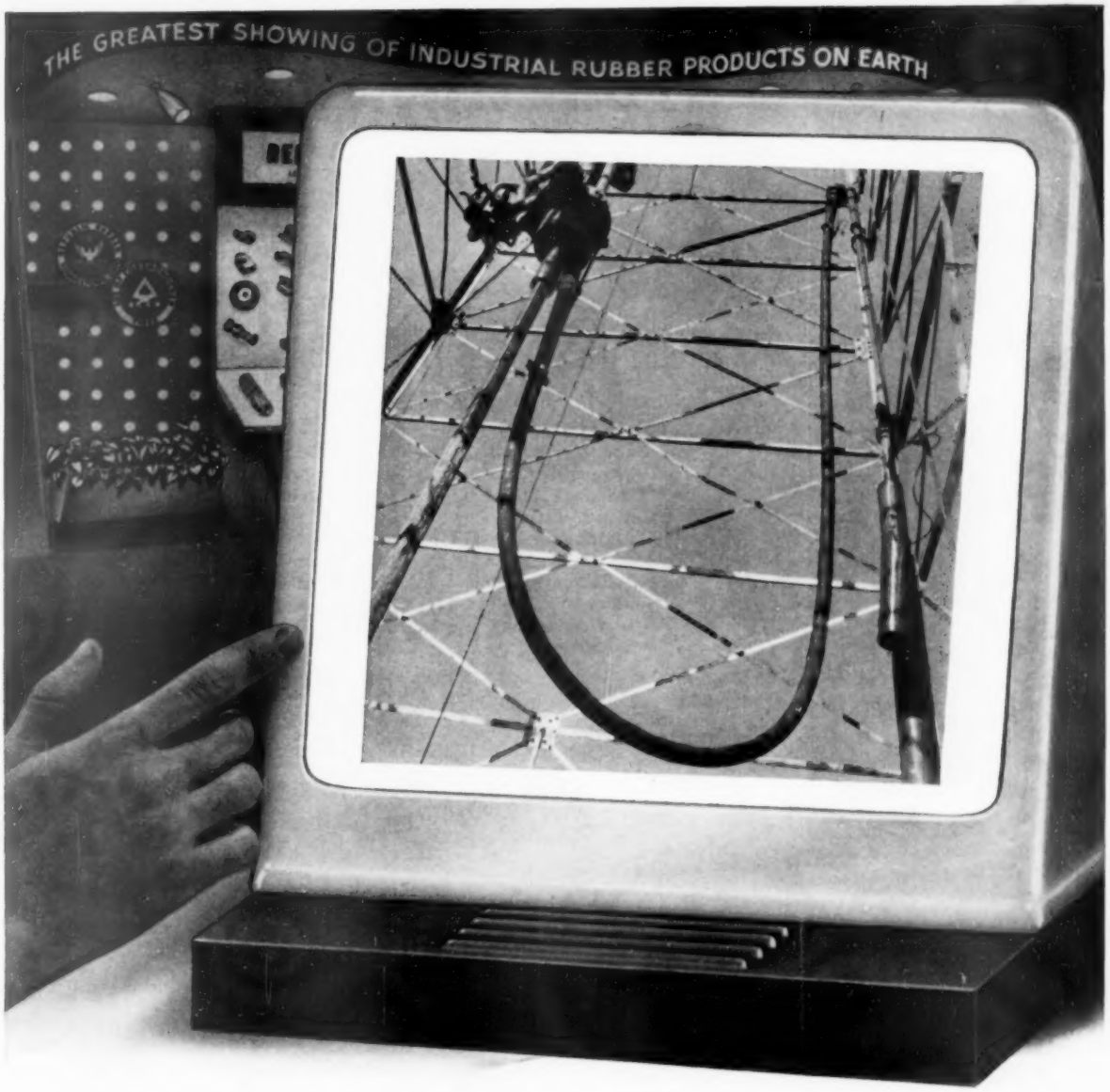


"CHAMPION" For A Champion

Your rig can be a champion, too! . . . a champion in efficiency and low-cost operation . . . a champion tour after tour, with fewer breakdowns and better production records. How? SPECIFY Republic's Champion Rotary Drilling Hose . . . a rotary drilling hose that will earn its right to work on your rig.

Champion Rotary Drilling Hose is designed to stand up longer under high, pulsating pressures. There are no bolts or flanges to catch on the rigging. The special flush-fitting, streamlined couplings, **hydraulically locked into** the hose carcass, will not leak or work loose.

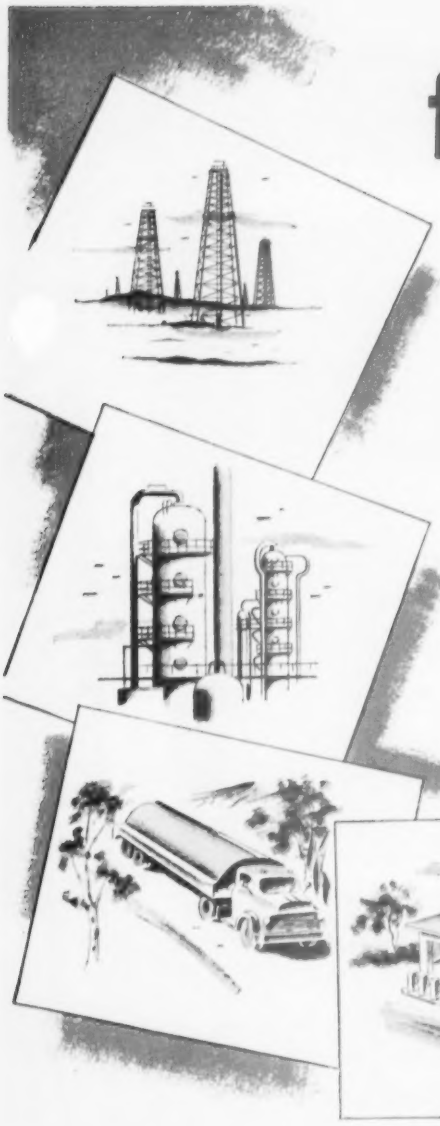
Your specialized Republic Oil Field Distributor can show the way to operating economy with Industrial Rubber Products. Call him soon or write directly to us.

MID-CONTINENT DISTRIBUTOR
Jones & Laughlin Steel Corporation, Supply Division
P. O. Drawer 2481, Tulsa 2, Okla.

REPUBLIC RUBBER DIVISION
LEE RUBBER & TIRE CORPORATION, YOUNGSTOWN 1, OHIO
INDUSTRIAL RUBBER PRODUCTS

WEST COAST DISTRIBUTORS
Hendrie Belting & Rubber Co.
405 Towne Ave., Los Angeles, Calif.
Pacific Coast Rubber Company
51 Main St., San Francisco, Calif.

from Rig to Retail "Liquid Aluminum"

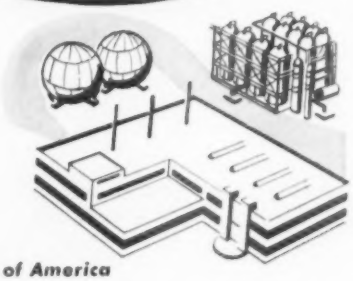


From your field installations to refineries to retail outlets, *Liquid Aluminum* offers low cost protection and cuts maintenance expense. *Liquid Aluminum* is amazingly resistant to money-eating rust . . . resists discoloration from smoke and fumes, too. It reflects up to 85% of heat and light rays . . . reduces evaporation losses . . . minimizes expansion and contraction problems . . . makes interiors brighter and exteriors more attractive. From costly rigs straight down the line to service stations, *Liquid Aluminum* protects and beautifies at modest cost.

Look for the *Liquid Aluminum* label on the aluminum paint you choose. It is your assurance of a quality product made by leading paint manufacturers to approved minimum standards. Ask your paint supplier or write for names of manufacturers to Reynolds Metals Company, 2595 South Third Street, Louisville 1, Kentucky.

ONE COAT PROTECTION FOR YOUR BUILT-UP OR RUSTABLE METAL ROOFS

It's *Liquid Aluminum* with asphalt for roofs. It will add years to roof life . . . and keep buildings cooler in summer to cut air conditioning costs and increase employee efficiency and morale. Look for the *Liquid Aluminum* label and the special Warranty Seal . . . they are your assurance of the right amount of aluminum pigment in an approved vehicle. Write for folder to address above.



This advertisement appears in the interest of the Paint Industry of America

FASTER

MORE EFFECTIVE... MORE DEPENDABLE

FIRE-STOPPING POWER

MODEL 20-B

ANSUL
Chemical Company
FIRE EQUIPMENT DIVISION • MARINETTE, WISCONSIN

ANSUL

FIRE EXTINGUISHING EQUIPMENT

FASTER . . . A short, quick downward motion of the puncture lever pressurizes the extinguisher and it is ready for instant use.

MORE EFFECTIVE . . . Even the inexperienced operator gets near-expert results because of the ease of operation and handling. In addition ANSUL *"PLUS-FIFTY"* Dry Chemical has greater fire-killing power.

MORE DEPENDABLE . . . Exclusive ANSUL-ENGINEERED design features include water-tight and corrosion-resistant construction, easy, on-the-spot recharge without special tools and other exclusive Ansul developments which insure greater dependability.

FIRE-STOPPING POWER . . . ANSUL FIRE EXTINGUISHERS have the highest ratings for fire-stopping power ever awarded any type of class B and C fire extinguishing equipment.

Send for File No. B-215. You will receive a variety of helpful printed matter. Included is our latest catalog which describes Ansul Extinguishers of all sizes — from the small Ansul Model 4 to Ansul Piped Systems and Ansul 2000 lb. Stationary Units.

OFFICES AND DISTRIBUTORS IN PRINCIPAL CITIES IN THE U. S. A., CANADA AND OTHER COUNTRIES

MANUFACTURERS OF
DRY CHEMICAL FIRE EXTINGUISHING EQUIPMENT, REFRIGERATION PRODUCTS, INDUSTRIAL AND FINE CHEMICALS AND LIQUEFIED GASES

You're sure of UNIFORM HIGH QUALITY

SEAMLESS • PRESSURE • MECHANICAL CARBON STEEL TUBES

when you specify GLOBE

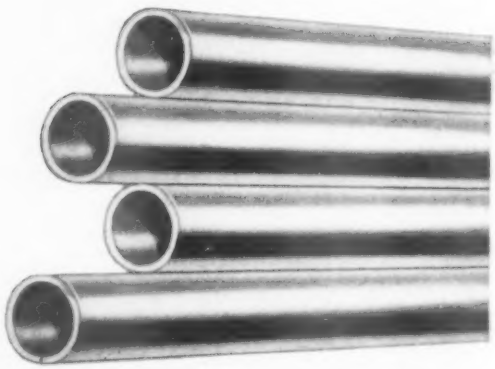
SIZE RANGE — WALL THICKNESS

Globe seamless carbon steel tubes are available in a size range of ½ inch to 7½ inches O.D.; wall thickness of .028 to 1.000 inch.

APPLICATIONS

Globe Pressure Tubes are used for boilers, condensers, heat exchangers and process equipment. They meet most exacting demands of modern high pressure and high temperature installations. Globe Mechanical Tubing (seamless) is produced by piercing solid billets. It is an ideal material for low-bearing structural members and parts where strength with minimum weight is needed. Its economy for the manufacturing of many machine parts is universally recognized.

Globe seamless carbon steel tubes are furnished to standard specifications in low and medium carbon ranges.



WHEN you specify Globe you are sure of uniform high quality carbon steel tubes. That's because they are the product of highly developed production facilities and specialized quality controls and methods.

Globe engineers are at your service to assist in the selection of tubing of the exact characteristics you require.

GLOBE TUBES

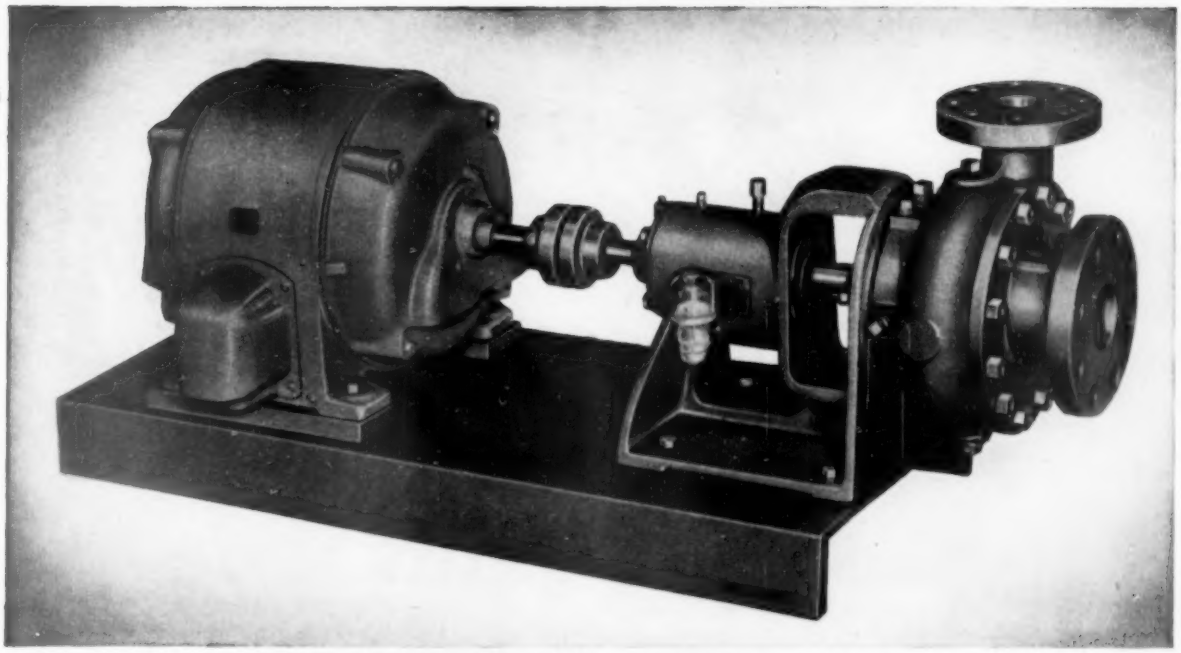
GLOBE

STEEL TUBES CO.

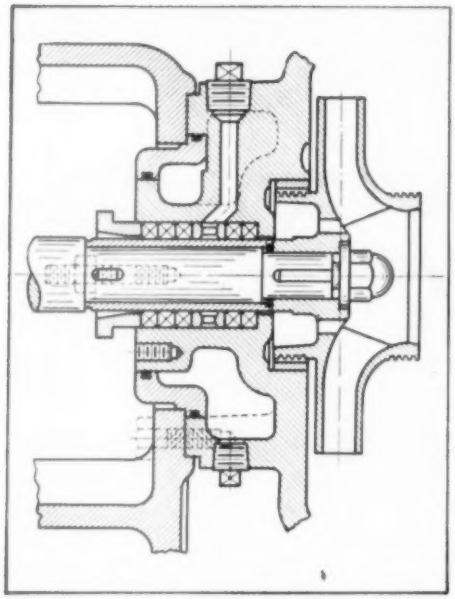
MILWAUKEE 46, WISCONSIN

Chicago • Cleveland • Philadelphia • St. Louis • New York • Detroit • Denver • Houston • San Francisco • Glendale, Calif.

Producers of Globe seamless stainless steel tubes — Gloweld welded stainless steel tubes — alloy-carbon seamless steel tubes — Globeiron (high purity ingot-iron) seamless tubes — Globe welding fittings.



THE NEW WORTHINGTON TYPE CNR CENTRIFUGAL PUMP is designed to give dependable, trouble-free performance on a wide variety of refinery jobs.



WATER-COOLED STUFFING BOX provides longer life for packing and bearings. Cross-sectional view shows water-jacketing.

Here's another Worthington pump that makes refinery operations more efficient

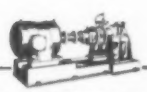
It's our compact, single-stage Type CNR centrifugal pump, built to handle such refinery jobs as treating, blending, loading and transfer.

Here are some of the features of the modern CNR centrifugals:

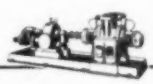
1. HEAVY CASINGS in iron or steel for extra wear under high pressure and corrosive conditions.
2. WATER-COOLED STUFFING BOXES with conventional packing or mechanical seals optional.
3. HEAVY-DUTY CONSTRUCTION with 250-pound ASA flanges (150-pound in steel) for really rugged service.
4. INTERCHANGEABILITY. The CNR is part of our SESC pump line. That means complete interchangeability of any pump component for easier servicing, broader range of pump selection and greater availability.

You can get the new CNR's in capacities up to 2700 gpm, to handle temperatures up to 350° F.

Write for Bulletin W341-B16 to Worthington Corporation, Centrifugal Pump Division, Harrison, New Jersey. C 3.9



Types HR and HB. Twenty sizes. Capacities up to 1,800 gpm. Developed heads up to 900 ft. Proper selection of material permits use for temperatures far below zero to 800 F, for pressures from high vacuum to 750 psig.



Type HD. Hydraulically-balanced double-suction impeller handles boiling liquids with low submergence. Capacities range from 600 to 3,200 gpm at heads up to 700 ft. To 850 F and 550 psig.

Type CNE. For loading or transfer service. Capacities to 2,700 gpm. Heads to 500 ft.

Type HM. Available in 12 sizes. Capacities to 700 gpm. Heads to 475 ft. Up to 500 F.

WORTHINGTON

Centrifugal Pumps

The World's Broadest Line Assures You the Right Pump for Every Job

INCREASE HORSEPOWER CAPACITY 40%

. . . and give you more use per dollar

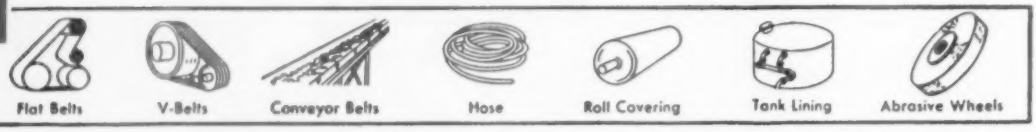
The combination of new synthetic fibers in the strength member of R/M Super-Power V-Belts assures greater resistance to shock loads, virtually no stretch, and practically eliminates matching problems. This, along with our straight side-walls, means better tensioning and grip, less slippage . . . more power delivered on the drive. Compared with regular V-belts you can handle approximately 40% greater load with the *same number* of R/M Super Power V-Belts or do an equal job with *fewer*.

Another plus . . . these V-belts are oil-proof, non-spark and heat-resistant. Send for Bulletin 6628. Ask the R/M distributor to show you how R/M Super-Power V-Belts will deliver "More Use per Dollar" on your drives . . . Condor V-Belts continue to be the standard for regular service.

R/M

MANHATTAN RUBBER DIVISION — PASSAIC, NEW JERSEY

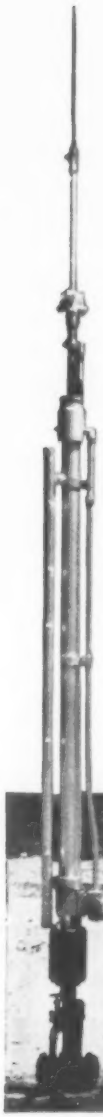
RAYBESTOS-MANHATTAN, INC.



Other R/M products include: Industrial Rubber • Fan Belts • Radiator Hose • Brake Linings • Brake Blocks • Clutch Facings
Asbestos Textiles • Packings • Engineered Plastic, and Sintered Metal Products • Bowling Balls

Around the clock operation
with
MARVEL *Synclinal* FILTERS

Milton J. Krebs, Chief Engineer of the S. C. Carter Company states: "Marvel Synclinal Filters are standard equipment on all Models of our CARTER Long-Stroke Hydraulic Oil Well Pumping Units, more than 500 of which are operating 24 hours a day in California, the Mid-Continent and Rocky Mountain areas, in Canada and as far afield as Trinidad, being thus subject to wide temperature ranges and severe operating conditions. The Marvel filters have given excellent results."



YES ! ! ! ANOTHER CASE OF PROVEN ACCEPTANCE

OVER 400 OTHER ORIGINAL EQUIPMENT MANUFACTURERS of hydraulic and other machines with low pressure liquid circulating systems install Marvel Synclinal Filters as standard equipment. They have recognized the superiority of Marvel's BALANCED Synclinal Design which provides that all important balance between maximum ACTIVE filtering area and sufficient storage capacity for filtered out particles.

They know that users of their equipment will obtain longer periods of efficient, productive operation at an absolute minimum in maintenance "down-time."

Marvel Synclinal Filters, both sump and line types, may be disassembled, cleaned and reassembled by any workman in a matter of minutes. Line type operates in any position and may be serviced without disturbing pipe connections. No spare or replacement parts to purchase or carry in stock.

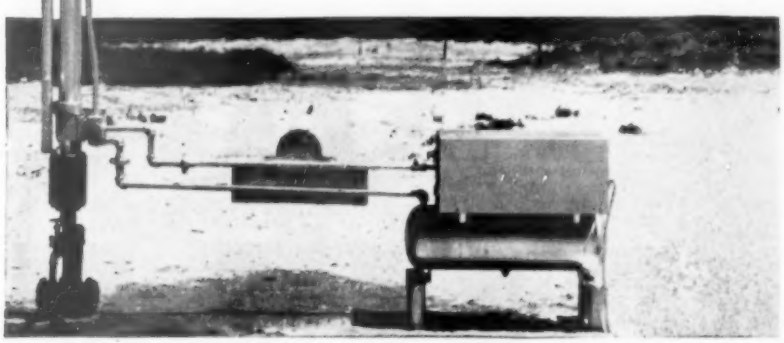
A SIZE FOR EVERY NEED

Available for sump or line installation in capacities from 5 to 100 g.p.m. Choice of monel mesh sizes ranging from coarse 30 to very fine 200.

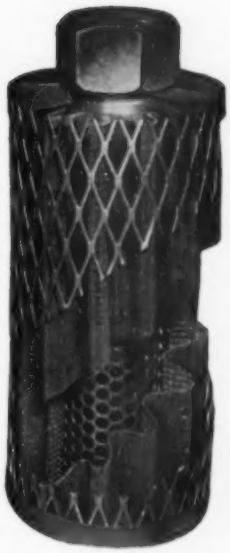
IMMEDIATE DELIVERY

Marvel not only delivers a top grade filter in both quality and performance, but delivers IMMEDIATELY. If desired, shipments are made the same day orders are received.

WATER FILTERS In response to the great demand, we have adapted both our sump and line type models for use in all water filtering applications. No changes have been made in the basic synclinal design.



Long-Stroke Hydraulic Oil Well Pumping Unit, Manufactured by the S. C. Carter Company.



SUMP TYPE
(Cutaway)

For installation on Hydraulic Systems in GEOPHYSICAL DRILLING RIGS, Shot Hole, Core, Slim Hole, Work Over, etc., Oil Well Drilling Rigs, Pipe Line Valves, Machine Tools, Pumping Units, Field Processing Valves and all Hydraulically Operated Construction Equipment.

LINE TYPE
(Cutaway)

For installation on Crank Case, Lube Oil Filtration, Pump Line Pumping Engines, Gas Compressors, Reciprocating Compressors (Single or Combination), Engines—Well Pumping or Drilling, and Hydraulic Powered Construction Equipment.

MARVEL *Engineering Company*

625 WEST JACKSON BLVD., CHICAGO 6, ILLINOIS

Phone: Franklin 2-4431

MARVEL ENGINEERING COMPANY OG-2
625 W. Jackson Blvd., Chicago 6, Ill.

Without obligation, please send me complete data on Marvel Synclinal Filters as follows:

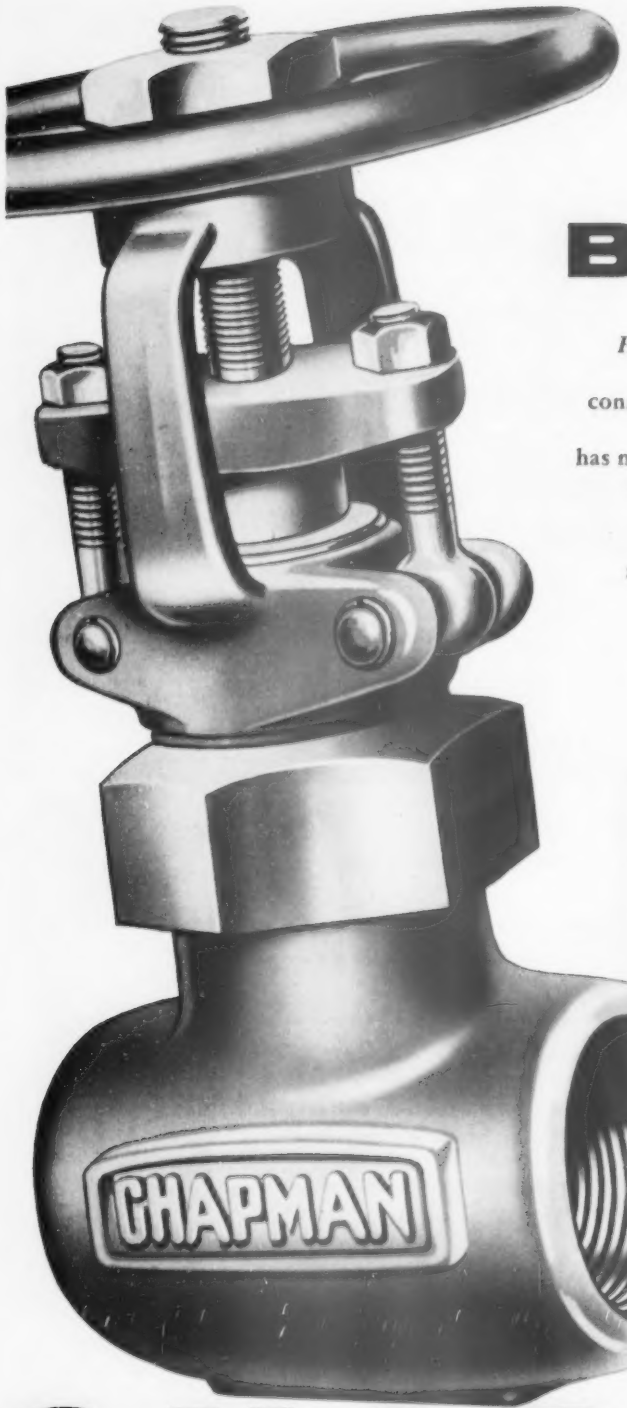
Catalog #106 for Oil Filters
Catalog #300 for Water Filters

Name.....

Company.....

Address.....

City.....State.....

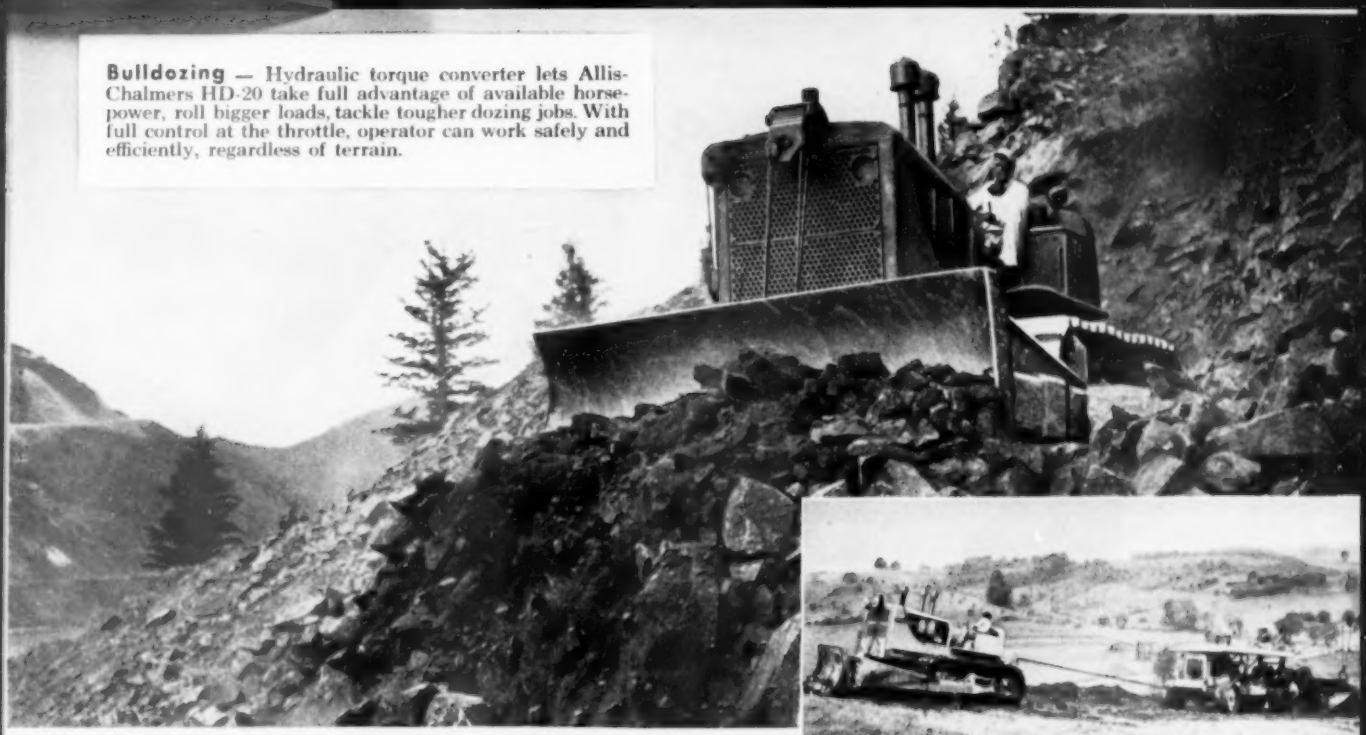


The Small Valve
THAT DOES THE
BIG JOB

Here's what you get: Extra protection against excessive stress with new extra-strong stem and wedge-gate connection . . . super-hardened seat rings of stainless steel . . . forged body and yoke (and bolted follower that has no threads to corrode) . . . plus Malcomized gate faces that won't seize or gall. Made in sizes from ½" to 2" inclusive, with choice of rising stem with yoke, or with inside screw. Bonnet joints either gasketed or metal-to-metal. Pressure range: 2,000 lb. at 100°F. — 380 lb. at 1,000°F. For higher pressures, specify List 990. Write for Catalog 10.

The CHAPMAN VALVE MFG. COMPANY
INDIAN ORCHARD, MASS.

LIST 960
CHAPMAN



Bulldozing — Hydraulic torque converter lets Allis-Chalmers HD-20 take full advantage of available horsepower, roll bigger loads, tackle tougher dozing jobs. With full control at the throttle, operator can work safely and efficiently, regardless of terrain.

AN ALLIS-CHALMERS REPORT

How hydraulic torque converter drive improves big tractor performance — increases job output

With a two-range transmission and hydraulic torque converter, the Allis-Chalmers HD-20 is the only crawler tractor that is capable of exerting maximum drawbar pull *at all times* . . . under all load and terrain conditions . . . without gear-shift guesswork.

Whatever the job, the operator need merely make contact with the load and then open the throttle. As the load requirements change, the hydraulic torque converter *automatically* matches the conditions with exactly the right combination of speed and pull.

This eliminates most shifting . . . leads to far more work done in a continuous work cycle . . . far longer equipment life.

• • •

Hydraulic torque converter drive, exclusive as standard equipment with Allis-Chalmers, is just one of many reasons why the HD-20 assures you higher output with less upkeep. Your nearby Allis-Chalmers dealer invites you to get the full story . . . and to see it in action.

WEIGHT — 41,000 LB. • 175 NET HP. AT FLYWHEEL

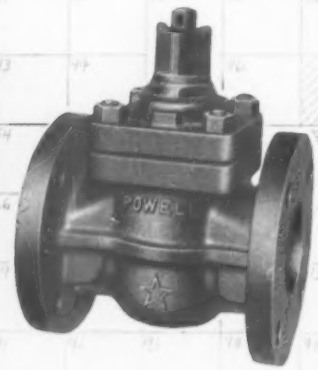
ALLIS-CHALMERS
TRACTOR DIVISION — MILWAUKEE 1, U. S. A.

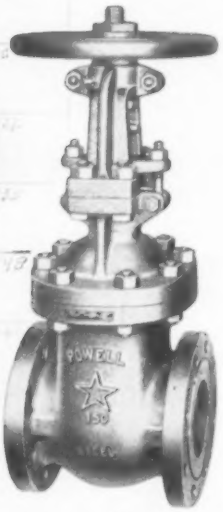
PULLING — Hydraulic torque converter drive actually multiplies torque up to four and one-half times . . . develops tremendous drawbar pull to start the load smoothly . . . and automatically accelerates to the highest speed that conditions permit, in either high or low range.

SIDE BOOM WORK — Torque converter drive makes it amazingly simple for operator to match cradling speed to cleaning-priming, doping-wrapping machines. And in soft, mucky bottom land the combination of torque converter drive and unusual flotation ability permits the HD-20 to creep along without becoming mired down.

DIGGING AND LOADING — With the HD-20G, the operator crowds surely and steadily, using only throttle and bucket levers. With full horsepower always available even at creeping speed, he can work effectively in mud, on hillsides or the edges of banks.

DEPENDABILITY IN 2 LETTERS





TOP

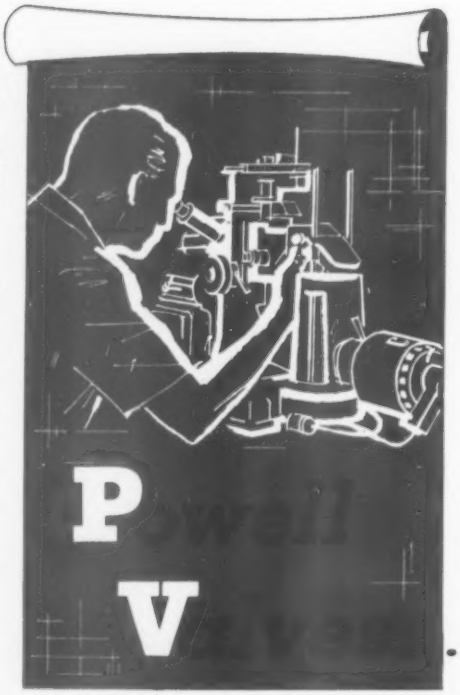
LUBRICATED PLUG VALVE *(Fig. 2201)* Flanged end. Available with screwed or bolted glands. Semi-Steel valves available for 175 and 200 pounds W.O.G. Carbon Steel Valves available for 150 and 300 pounds W.P.

LEFT

BRONZE "WHITE STAR" GATE VALVE *(Fig. 375)* For 200 pounds W.S.P. Union bonnet with inside screw rising stem. Renewable "Powellium" Nickel-Bronze wedge. Sizes, ¼" to ¾", Solid Wedge; 1" to 3", Double Wedge.

RIGHT

CAST STEEL GATE VALVE *(Fig. 1503)* 150 pounds. Flanged ends, bolted flanged bonnet with outside screw rising stem and yoke. Solid wedge. Available in sizes 1" to 24", inclusive.



The life of a valve bears a certain relation to the life of the company that produces it. Powell has had a solid, oak-like growth for over a hundred years. That's only possible because The William Powell Company makes dependable valves.

Today, Powell Valves are proving their dependability in a greater variety of installations than any other valves in the world. And Powell is very likely the leader in research as well as development of special valves to overcome flow control problem situations.

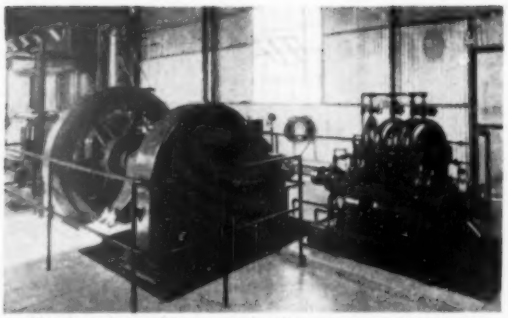
All good reasons why PV, for Powell Valves, appears on more specifications year after year.

THE WILLIAM POWELL COMPANY
CINCINNATI 22, OHIO

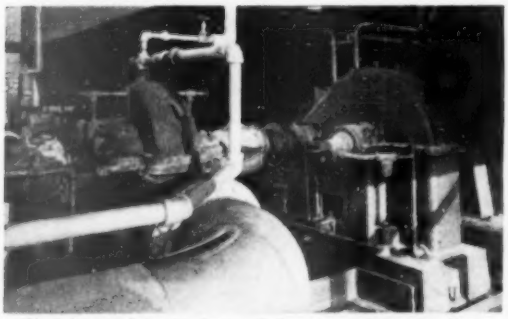
CONTROLS FOR THE LIFE LINES OF INDUSTRY

.....108th YEAR

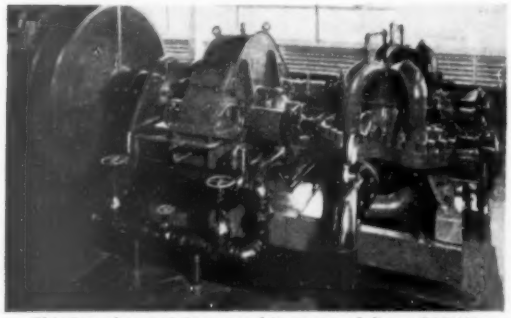
3 FACTS TO REMEMBER! when you buy speed increasers



This Farrel speed increaser has been in operation since 1932. It transmits 250 HP from a gas engine to a centrifugal pump.



Farrel speed increasing unit in an outdoor installation at a gasoline absorption plant.



This Farrel two-pinion speed increaser delivers 300 HP to each of two pumps from a single 600 HP engine.

1 PERFORMANCE RECORD

For many years, Farrel® has worked closely with the oil industry in designing speed increasers to provide continuous, trouble-free operation with a minimum of down-time for maintenance and adjustment. How successful this program has been is shown by the record. Of the hundreds and hundreds of units installed in pipeline pumping stations since 1932, *all* are still operating successfully.

2 FOR ANY SERVICE CONDITIONS

Farrel engineering can solve your special service problem. For example, units for outdoor service have been developed for successful operation under the most adverse conditions – continuous heavy-duty operation, dust, rain, sandstorms, severe heat and intense cold.

3 TO YOUR REQUIREMENTS

Farrel speed increasers are available in a standard line with ratios ranging from 1:1 to 12:1. For higher ratios, double step-up units are supplied with ratio range from 12:1 to 40:1. Two pinion units, designed to transmit power from a single engine to two pumps, are also available. These can be furnished with any gear ratio required.

FARREL-BIRMINGHAM COMPANY, INC., ANSONIA, CONN.

Plants: Ansonia and Derby, Conn., Buffalo, N. Y.

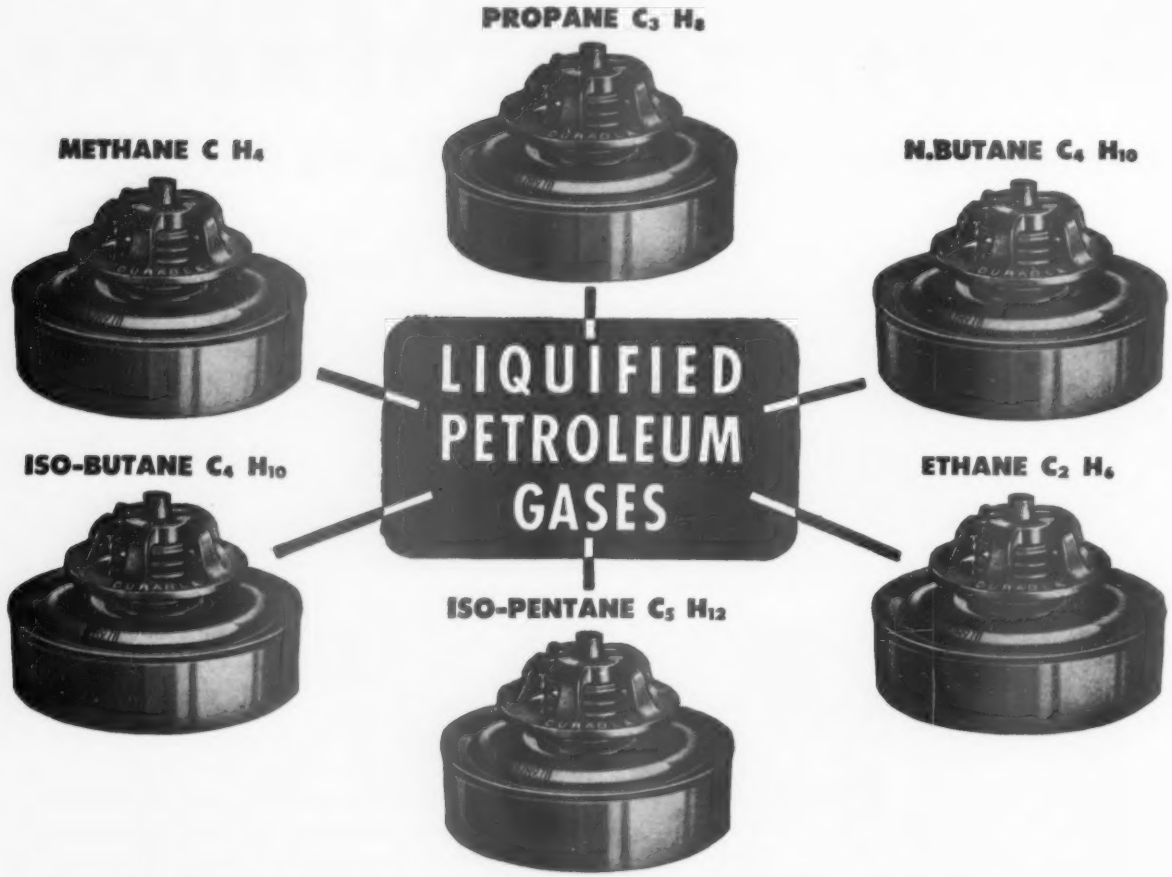
Sales Offices: Ansonia, Buffalo, New York, Boston, Akron, Detroit, Chicago, Memphis, Minneapolis, Portland (Oregon), Los Angeles, Salt Lake City, New Orleans

OIL FIELD REPRESENTATIVES

Hercules-Lupfer Engine Sales Co., 124 N. Boston St., Tulsa 1, Oklahoma, V. W. Osborne, 860-A M & M Building, Houston 2, Texas

Farrel-Birmingham®

FB-858



DURABLA PUMP VALVES FOR LIGHT HYDROCARBONS

When close clearance or any other design of reciprocating pumps are used for handling the greatly increased production of light hydrocarbons, DURABLA METAL PUMP VALVE UNITS* are your guarantee of high performance, freedom from "gassing" and replacement problems. The arched and curved shape of the valve member absolutely minimizes "slip", cavitation, and turbulence. DURABLA Valves are precision engineered, especially for this service.

Pump valves all open with a tilt action towards the flow line or line of least resistance. DURABLA Valves, being free-tilting, follow this natural law, which is not possible with high hub stem-guided valves or wing guided valves where large side friction is caused when they attempt to tilt in accordance with this basic law . . . and no other free tilting valve is as light as the DURABLA Valve.

ONLY DURABLA OFFER ALL THESE ESSENTIAL FEATURES FOR LIGHT HYDROCARBON SERVICE

- **Feather Weight Valve Member**
- **Free-Tilting Valve Member Without Side Friction**
- **Snap Action Under Any Load**
- **Positive Seal Independent of Contraction and Expansion of Gases**
- **Does Not Need Lubrication**
- **Compact Design, Stocked in 11 Standard Sizes to Fit Any Pump**

Write DURABLA Engineering Department for information and Bulletin, Reference OG-2

*Patent Numbers 2090486, 2117504

DURABLA MANUFACTURING COMPANY
114 LIBERTY ST. NEW YORK
BRANCHES IN PRINCIPAL CITIES. FOR CANADA REFER: CANADIAN DURABLA LIMITED, TORONTO

⅜—11 x 3½ Stainless Steel Machine Bolt. One of over 7,000 different stock items.

BOLTS
NUTS
SCREWS
RIVETS
WASHERS

of

BRASS
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SPECIALISTS IN ALL CORROSION-RESISTANT FASTENINGS

EVERLASTING FASTENINGS

Over 7,000 different items in stock. Call the Harper Branch Office or Distributor nearest you.

THE H. M. HARPER COMPANY
8208 Lehigh Avenue, Morton Grove, Illinois

AERO DIVISION

FASTENINGS OF HIGH-TEMPERATURE ALLOYS

SPEAKING OF HORSEPOWER...

. . . whether you need TWO or A THOUSAND, there's a Continental Red Seal model Engineered and Built for Your Job

Now that the military models developed jointly with Army Ordnance are available for civilian uses, you can get Continental power for commercial applications at just about every power level from a lawnmower up to a tank. These air-cooled military series, from 375 to more than 1,000 horsepower, have been thoroughly proven under combat conditions. Their performance has been such as to forecast their adoption for many civilian jobs, especially those requiring high power-to-weight ratio, ease of maintenance, and stamina for sustained peak loads. If your needs fall between 2 and 1,040 horsepower, you'll fill them *best* with the Continental Red Seal engineered and built to your job.

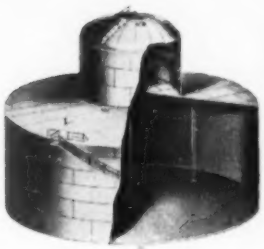
1819 BROADWAY, NEW YORK 23, N. Y. • 6218 CEDAR SPRINGS RD., DALLAS 9, TEX. • 910 S. BOSTON ST., TULSA, OKLA.

PARTS AND SERVICE COAST TO COAST

Continental Motors Corporation
MUSKEGON • MICHIGAN

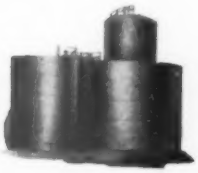
1252 OAKLEIGH DRIVE, EAST POINT (ATLANTA) GA. • 3817 SOUTH SANTA FE AVENUE, LOS ANGELES 58, CALIFORNIA.

the HAMMOND DIALIFT*



MONEY SAVER FOR PRODUCT-STORAGE OPERATORS!

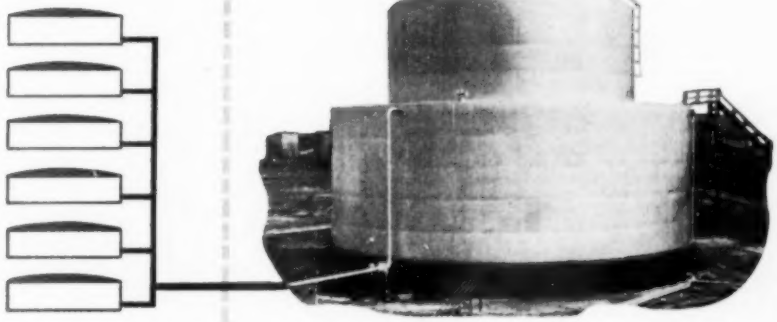
The Hammond DIALIFT is the modern tank for eliminating breathing losses and reducing filling losses. It gives maximum conservation of vapors at lowest cost.

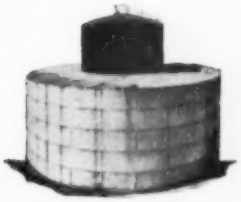


42'6" x 40' Liquid Storage Tank
22' x 17'9" Dialift. Housing — 6500 cu. ft. capacity Inter connected to a 25' x 40' Cone Roof Tank

50' x 48' Liquid Storage Tank
30' x 15'9" Dialift. Housing — 12,500 cu. ft. capacity

The DIALIFT consists of a tubular membrane attached gas-tight to the inside periphery of a cylindrical housing. In operation the DIALIFT functions as the lung of the storage tank. The membrane lifts under a slight pressure when additional vapor storage space is needed, and lowers when less vapor space is required; self-adjusting to the constantly changing breathing conditions within the tank.





80' x 30' Liquid Storage Tank
35' x 17'9" Dialift. Housing — 20,000 cu. ft. capacity

It is easy to convert an existing Cone Roof Tank to an efficient DIALIFT installation. A DIALIFT housing is superimposed on the existing roof, breather holes are installed through the roof plating permitting a free passage for all vapors, no other preparation is necessary.

60' x 48' Ground Type Dialift. 150,000 cu. ft. capacity

*patented

Bulletin 53DL details and describes the Hammond Dialift . . . *Write for your copy.*

HAMMOND IRON WORKS

WARREN and BRISTOL, PA. • PROVO, UTAH • CASPER, WYO. • BIRMINGHAM, ALA.

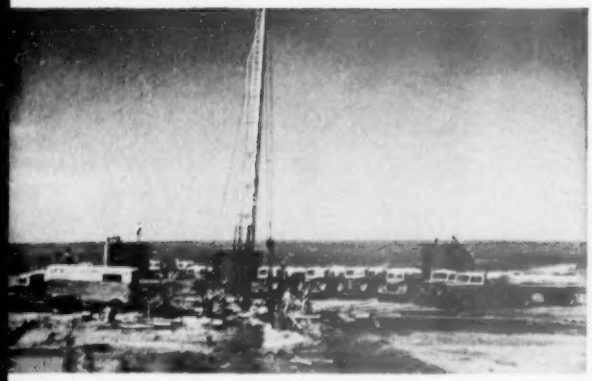
Sales Offices: NEW YORK 20 • AKRON • BOSTON 10 • BUFFALO 2 • CHICAGO 3 • CINCINNATI 2 • CLEVELAND 15 • EL PASO • HOUSTON 2 • LOS ANGELES 14 • PITTSBURGH 19 RICHMOND 20 • SAN FRANCISCO • WASHINGTON 6, D.C. • HAVANA • "TIPSA" BUENOS AIRES

ON THE PACIFIC COAST BY **LACY** *MFG. CO. • LOS ANGELES, CAL. • IN CANADA BY* **VULCAN** *IRON & ENG. LTD. • WINNIPEG*

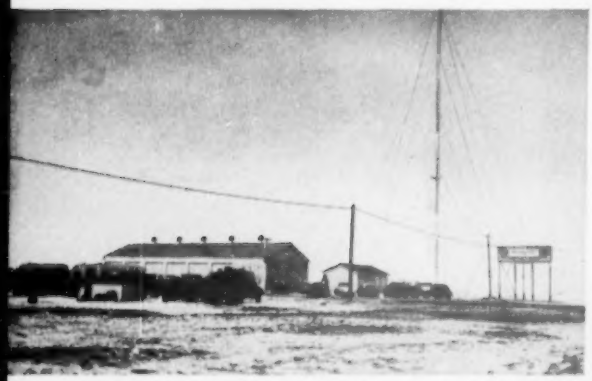
HALLIBURTON

Provides nation's largest efficiency by using

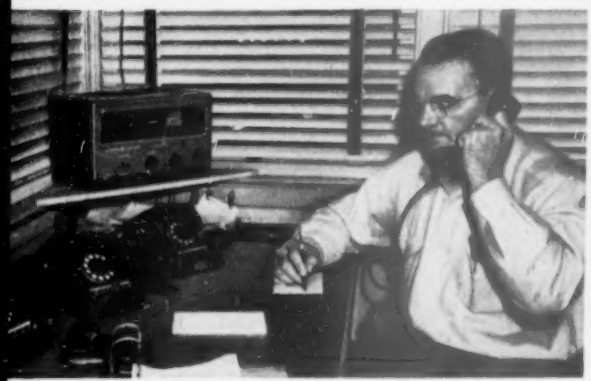
GE 2-WAY RADIO



● The equipment and personnel for a large acidizing treatment of Kansas well is dispatched and aided by General Electric two-way radio at HOWCO's Great Bend office.



● 300' tower and powerful G-E base station at HOWCO's Tioga, North Dakota camp keeps in touch with field units operating in below zero weather near the Canadian border.



● Duncan dispatcher, J. W. McClanahan, receives call from well site 43 miles away via G-E two-way radio. Instant communication with all field operations enables Halliburton to schedule equipment and expedite service throughout the oil field.

● The latest addition to Halliburton's fleet, the world's first ocean-going cementing ship, heads out for water job near the mouth of the Mississippi River. This ship is completely equipped with the latest equipment, including G-E two-way radio to provide instant communication with dispatcher at Harvey, Louisiana.

"YEARS AHEAD WITH G-E RADIO!"

oil field service . . . earns reputation for unparalleled G-E 2-way facilities!

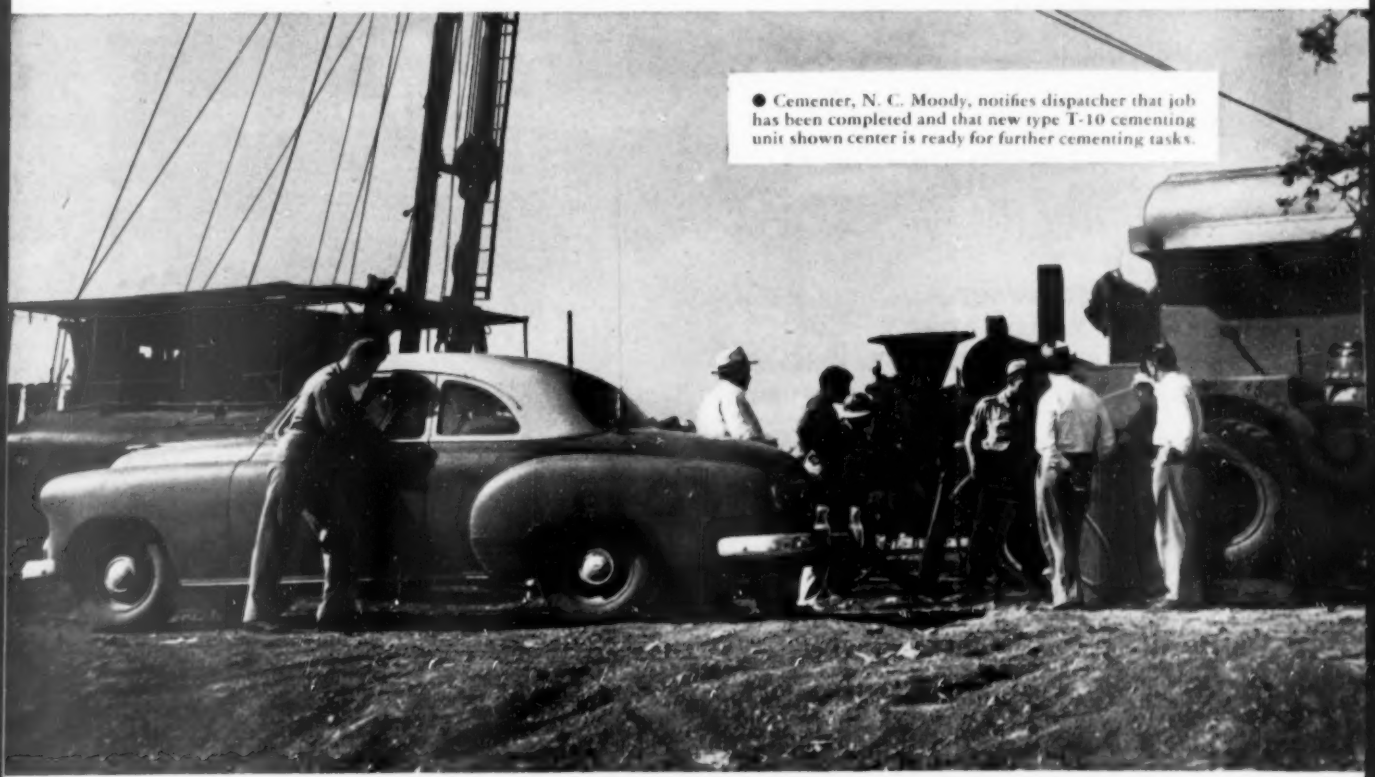
IN ADDITION to its reputation as the leading oil field service organization, HOWCO has long been famous for its constant efforts to develop tools and methods to further improve service in the petroleum industry. As part of this program, HOWCO has installed one of the world's largest privately owned two-way radio communications systems.

Over 700 General Electric 2-way mobile radio units and 70 base stations are used to coordinate activities and insure prompt service to its customers.

Halliburton officials credit G-E communications not only for always reliable performance but as an important tool for getting every job done efficiently . . . promptly —whether it be in the snows of North Dakota, the sandy plains of New Mexico, or the swamps of Louisiana!

Remember, when radio will solve one or a hundred problems for you . . . General Electric will do it best! Call the CAS* man at a local G-E office today or write for information. *General Electric Company, Section X824-15, Electronics Park, Syracuse, New York.*

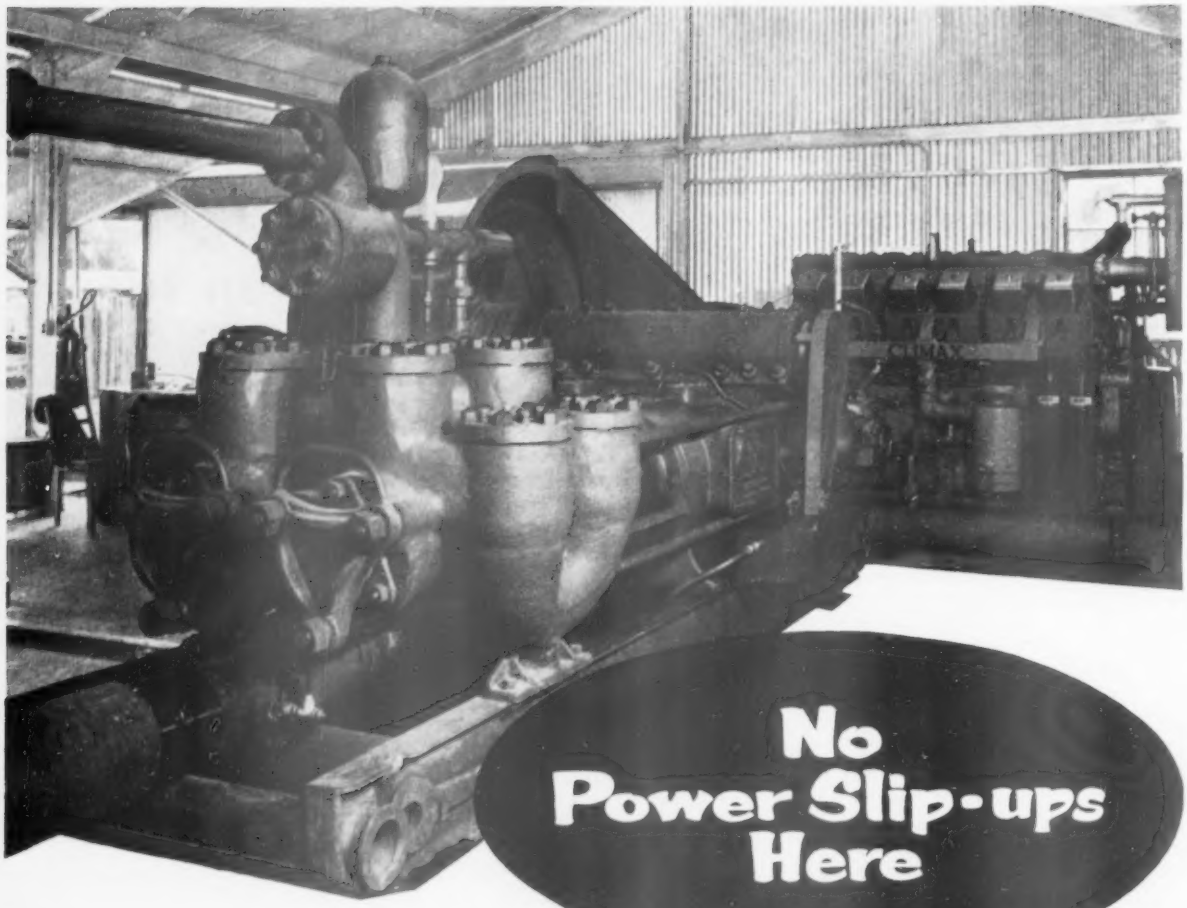
*Communications Advisory Service



● Cementer, N. C. Moody, notifies dispatcher that job has been completed and that new type T-10 cementing unit shown center is ready for further cementing tasks.

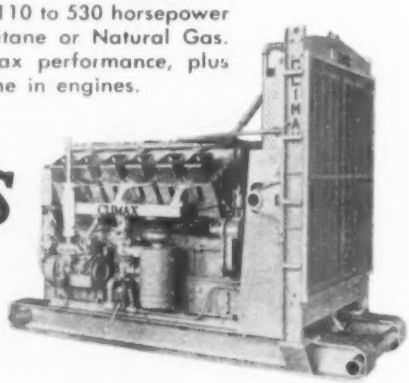
You can put your confidence in—

GENERAL ELECTRIC



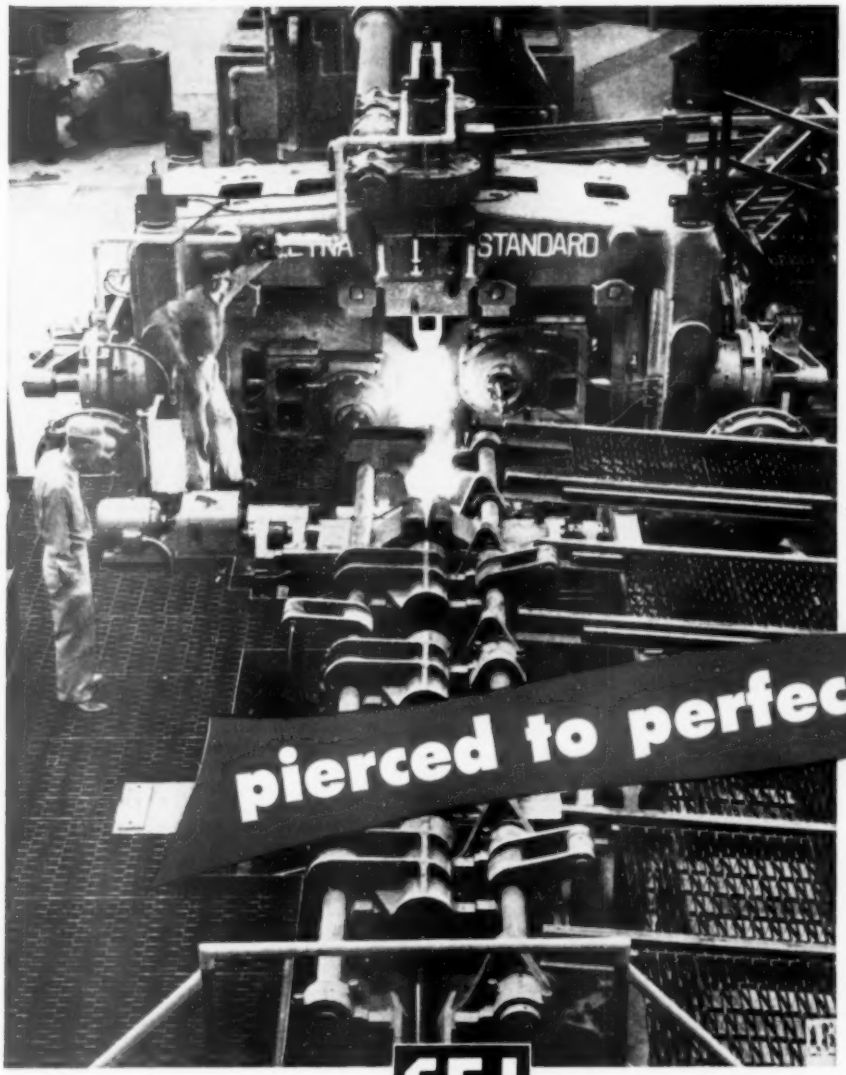
MISSION MANUFACTURING CO. RELIES ON CLIMAX BLUE STREAK FOR DEPENDABLE POWER IN TESTING FLUID END PARTS FOR SLUSH PUMPS

There's good reason why a Climax Blue Streak Engine was the choice of power to drive Mission's slush pump for experimental tests. To give fluid-end slush pump parts rigid tests for durability and exacting performance, it was demanded that the source of power feature compactness, provide uninterrupted operation and function economically under continuous heavy loads. A Climax Model V-125 filled the bill. And Climax has the features demanded by your operation, too. For every oil field requirement there is a Climax Blue Streak Engine to furnish smooth reliable power with minimum maintenance. In fact, there are seven modern models with power ranges from 110 to 530 horsepower . . . each designed to operate with equal efficiency on either Butane or Natural Gas. Your nearby Climax Distributor is unxious to explain why Climax performance, plus famous Blue Streak Service, makes Climax the number one name in engines.



climax
BLUE STREAK ENGINES

CLIMAX ENGINE AND PUMP MFG. CO.
208 SO. LA SALLE ST. CHICAGO 4, ILL.
FACTORY CLINTON, IOWA • DISTRICT OFFICE 155 CONTINENTAL AVE. DALLAS 7, TEXAS



pierced to perfection . . .

AT THE NEW CF&I SEAMLESS TUBE MILL

Here at the number one piercing mill a red hot billet is pierced to perfection . . . the start of an exacting operation to produce quality Seamless Oil Country Tubular Goods. CF&I's technical skill and modern, efficient equipment have earned a reputation for producing quality steel products.

CF&I's Seamless Oil Country Tubular Goods, now available from Pueblo, Colorado, meet API STD 5A specifications and range in size from 2⅜" O.D. through 9⅝" O.D. For quality Seamless Oil Country Tubular Goods, specify CF&I.

1905

CF&I TUBULAR PRODUCTS

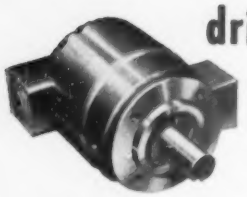
THE COLORADO FUEL AND IRON CORPORATION

DENVER, COLORADO

CF&I

Denison HydrOlLic Equipment

drives rotary table in versatile FRANKS rig



PUMP/MOTOR

1½" 4-WAY VALVE

1¼" RELIEF VALVE

Rated for 3500' of 8¾" hole, this new self-propelled FRANKS rig not only cuts servicing, workover and drilling costs, but also saves moving time because of its simple hydraulic rotary table drive and mast activation.

It calls for a high degree of compact, close-coupled efficiency in every detail—including the Denison HydrOlLic Equipment used in the rotary table drive.

A Denison vane type Fluid Motor, driven by a similar Denison Pump connected to the drive from the truck engine, develops 50 hp at 300 rpm on the table. Operation is extremely smooth and quiet at all speeds.

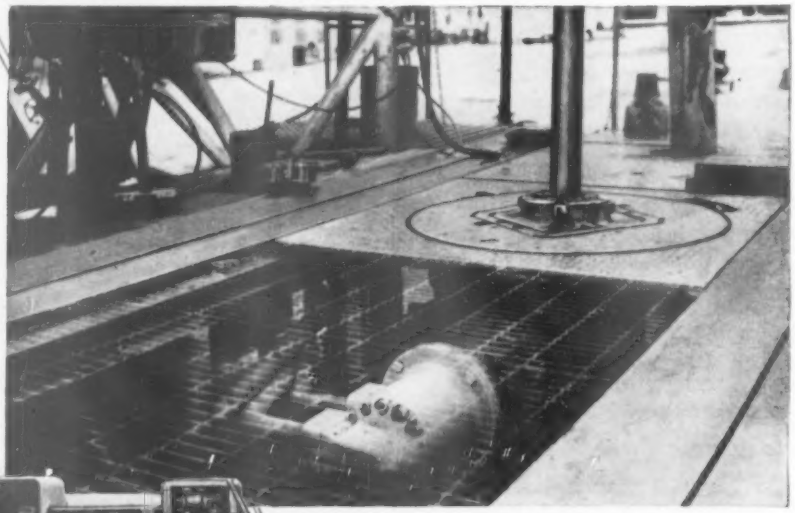
The hydraulic rotary table drive also prevents twist-off of the drill stem by controlling torque to the bit. In addition, torque exerted on the drill stem can be determined quickly at any time, by simply checking a gauge indicating pressure developed in the hydraulic drive circuit.

Because oil is pumped to the fluid motor through flexible hose and couplings, it is a simple matter to slide the table to one side to drill the rat-hole.

A Denison 4-way Control Valve provides for directing pump volume to either the rotary table or to the power tongs, as desired. A Denison Relief Valve prevents system pressures from exceeding the preset maximum.

This highly efficient FRANKS rig below is one of many types of oil-field equipment in which Denison HydrOlLic Components play a big part. Denison now offers today's most widely practical line of Pumps, Motors and Controls for circuits operating at pressures up to 5000 psi. Wherever you need *power, pressure or motion* that is quickly adjustable to a wide range of exacting needs, specify Denison HydrOlLic Equipment. You'll get a bonus in long, low-cost service with minimum maintenance—as proved by years of actual performance under many of industry's toughest operating conditions. For further information at any time, call or write the Denison office nearest you.

FRANKS "JUNIOR CLIPPER" MOBILE UNIT



Above: A dual exposure (before and after removal of deck grille) showing the Denison Pump/Motor connected to the rotary table. Note flexible oil lines.

DENISON HydrOlLics

PUMPS | MOTORS | CONTROLS | PRESSES

The Denison Engineering Co., 1176 Dublin Road, Columbus 16, Ohio

FACTORIES AND HOME OFFICES

WEST COAST BRANCH	HOUSTON BRANCH	CHICAGO BRANCH	NEW ENGLAND BRANCH
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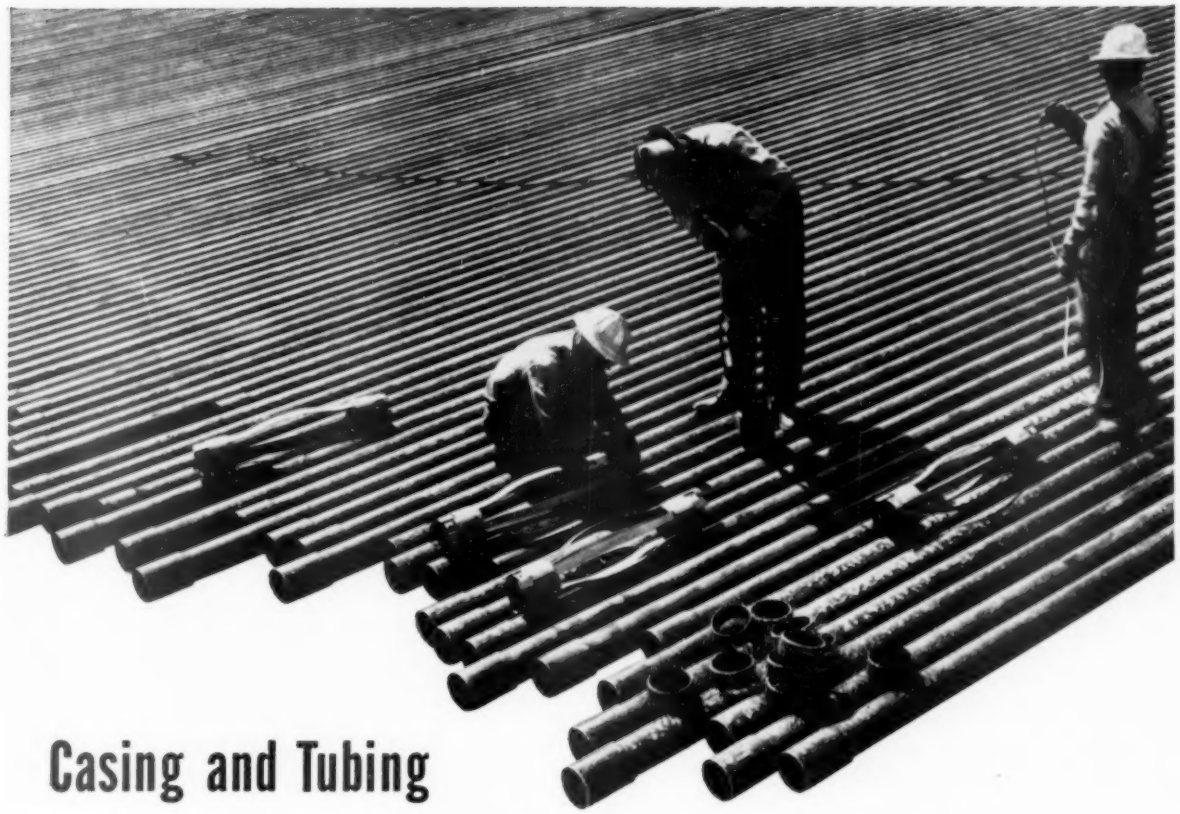
Tel: Osborne 5-3230	Tel: JUstin 6232	Tel: Reliance 5-7474	Tel: Mitchell 9-1665
(or) Oregon 8-6069			(or) Mitchell 3-5107



Casing and Tubing for Almost Every Depth....From One Source

Now . . . when you order casing and tubing . . . you can get top quality seamless as well as electric weld oil country goods from one source—Republic. And because the new seamless mill is located in Chicago, on the Calumet River, prompt shipments can be made to oil and gas fields by river barge down the Mississippi as well as by rail.

The new seamless casing and tubing sizes run from 2⅜" through 9⅝" and in grades J-55 and N-80. Electric weld casing and tubing, in sizes 2⅜" through 13⅜", grades H-40 and J-55. You can get more information on both of these products from your nearest Republic Sales Office. Or write to:

REPUBLIC STEEL CORPORATION
GENERAL OFFICES • CLEVELAND 1, OHIO
Export Department: Chrysler Building, New York 17, N. Y.

If you would like a quick picture trip through Republic's new Seamless mill, write for this new 24-page booklet. Ask for number Adv. 595.

Republic
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Electric Weld and Seamless

Other Republic Products include Line Pipe—Carbon, Alloy and Stainless Steels—Studs, Bolts and Nuts—Electrunite Heat Exchanger Tubes

It's EASY to plan your tower lighting

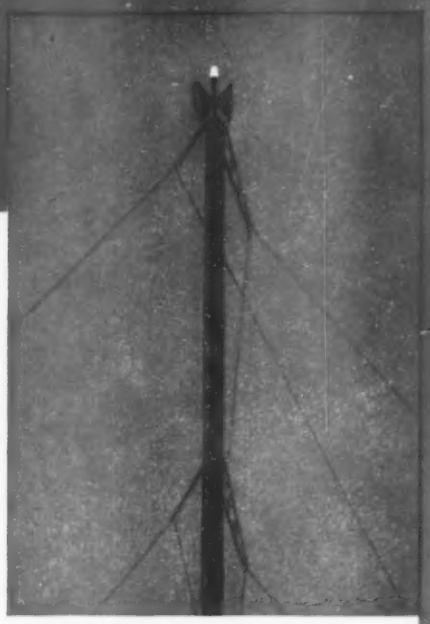
. . . television, radio, or microwave relay . . .

with CROUSE-HINDS Tower Lighting Bulletin

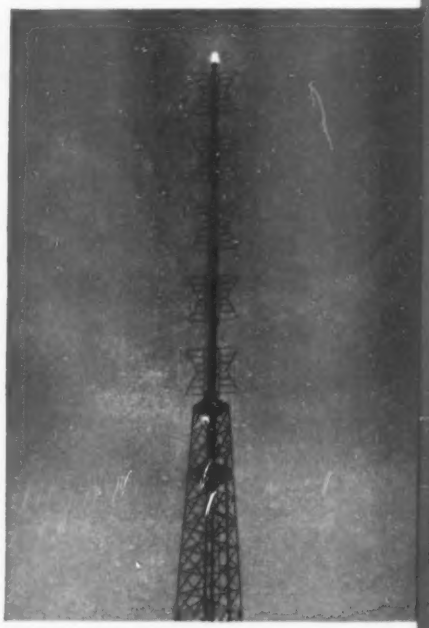
Crouse-Hinds Technical Data Bulletin 381-F contains important information on television, radio, and microwave relay tower lighting and tells you exactly what you need to do the job. There are layout drawings with complete bills of material for lighting towers of all heights. All of the information meets the requirements of FCC and CAA specifications.

A complete line of alarm relay equipment is available for remote indication of lamp failure as required by the FCC for unattended stations.

Send for your copy of this helpful bulletin today.



A Microwave Relay Tower with Crouse-Hinds Obstruction Lighting Equipment



A Television Tower with Crouse-Hinds Obstruction Lighting Equipment

CROUSE-HINDS COMPANY
Syracuse 1, N. Y.

OFFICES Birmingham — Boston — Buffalo — Chicago — Cincinnati — Cleveland — Dallas — Denver Detroit — Houston — Indianapolis — Kansas City — Los Angeles — Milwaukee — New Orleans New York — Philadelphia — Pittsburgh — Portland, Ore. — San Francisco — Seattle — St. Louis — St Paul Tulsa — Washington — RESIDENT REPRESENTATIVES Albany — Atlanta — Baltimore — Charlotte Corpus Christi — Reading Pa. — Richmond Va. — Shreveport
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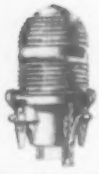
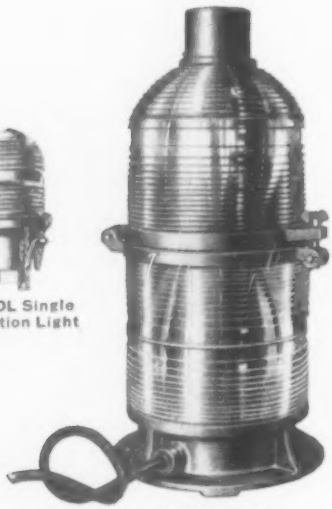
Photoelectric Control provides automatic operation of lighting circuits



Type EOL Single Obstruction Light



Type FCB-12 Fresnel Beacon

Type TSS Flashing Switch

A Nationwide Distribution Through Electrical Distributors

AIRPORT LIGHTING · FLOODLIGHTS · CONDULETS · TRAFFIC SIGNALS

for lower cost control of moderately **Corrosive** fluids

Fig. 2651-A Gate

JENKINS

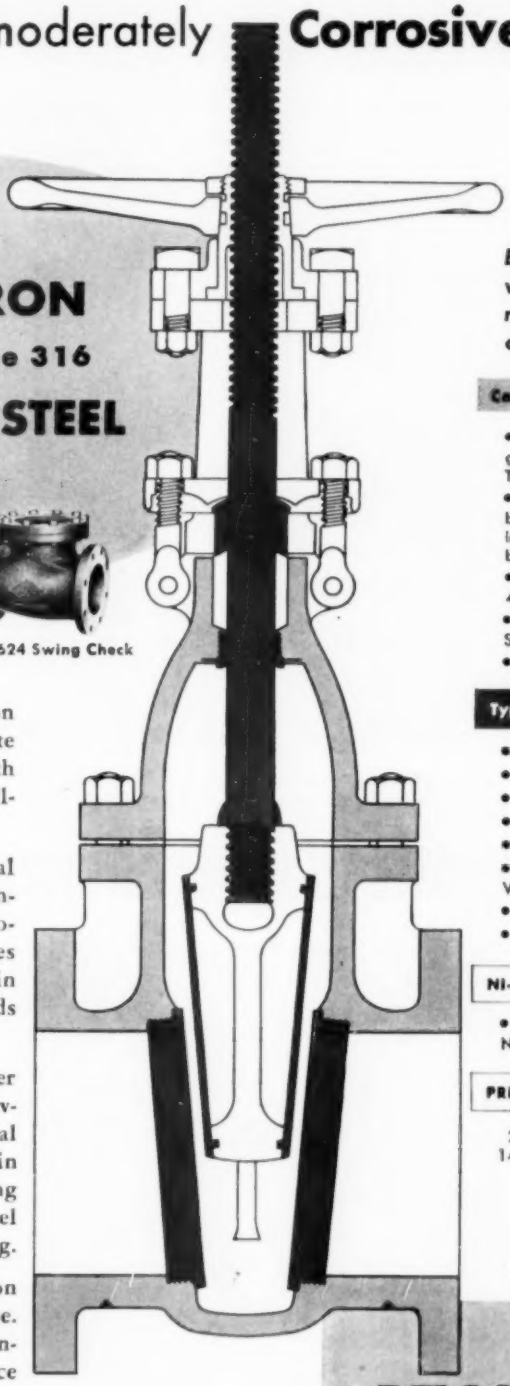
NICKEL IRON

Valves with Type 316

STAINLESS STEEL

Trim

Fig. 2624 Swing Check



Every part in contact with fluid is the right metal to block corrosion and beat wear.

Cast NICKEL IRON

- **BODIES** Heavy duty, dimensioned for greater resistance to wear and abuse. Through port design in Gate Valves.
- **BONNET** Rugged construction, like body. Swing-type gland bolts. Screwed-in back-seating bushing. Deep stuffing box.
- **YOKE** Integral with bonnet in 2″ to 4″ sizes.
- **WEDGE** In 10″ to 24″ sizes, with Stainless Steel Wedge Rings.
- **COVER** In Check Valve.

Type 316 STAINLESS STEEL

- SPINDLE
- GLAND
- BONNET BUSHING
- SPINDLE RING
- WEDGE PIN
- WEDGE RINGS Rolled into Nickel Iron Wedge in 10″ to 24″ sizes.
- SEAT RINGS
- DISC and HANGER in Gate Valve

NI-RESIST Type No. 2

- WEDGE of I-beam structure is solid NI-RESIST in 2″ to 8″ sizes.

PRESSURE RATINGS

2″ to 12″—200 lbs. O.W.G.
14″ to 24″—150 lbs. O.W.G.

This combination provides corrosion resistance well above the moderate need in many processing services with an investment well below that for all-stainless steel valves.

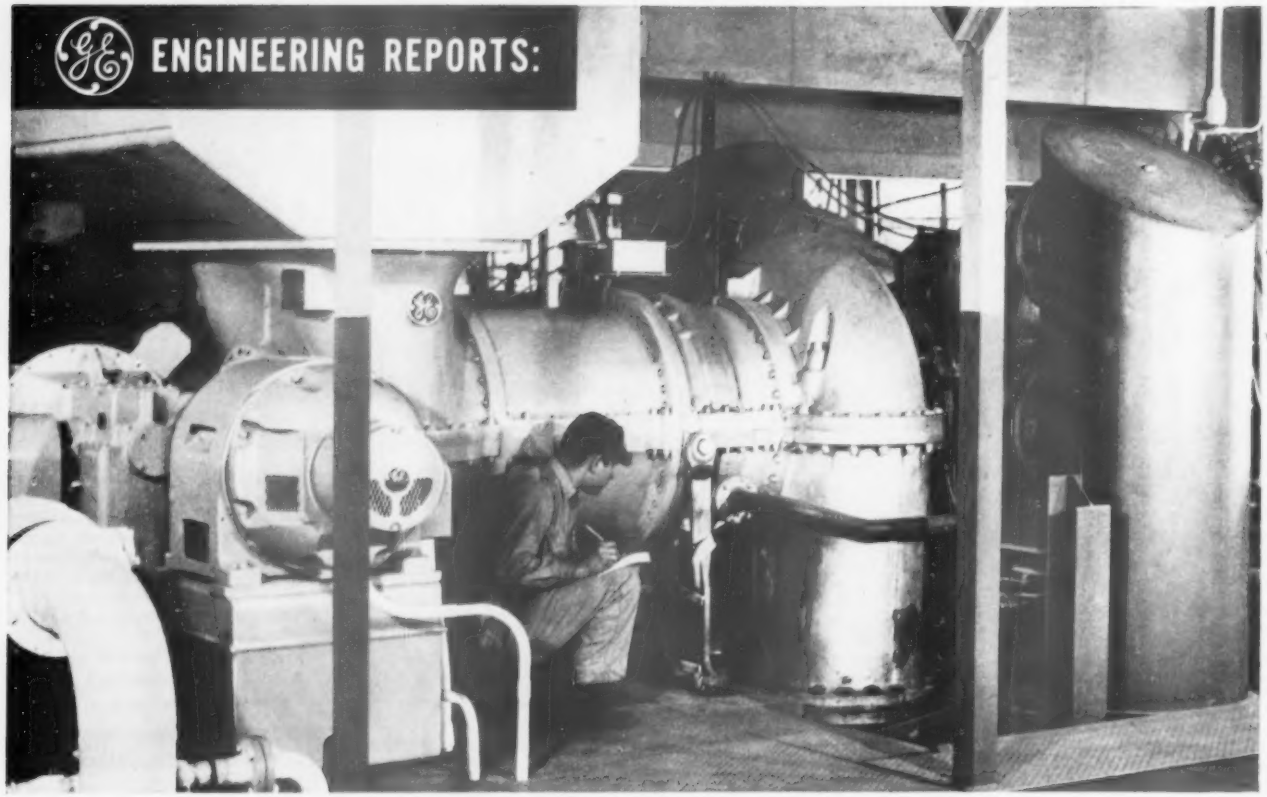
Designed primarily for the chemical process industries, they are recommended for control of mildly corrosive liquids with minimum quantities of mineral acids, such as creosote in wood treatment, and many liquids carried in petroleum processing.

A major use is in pulp and paper processing, particularly in lines serving the digester, and in the chemical recovery cycle. Service records in lines carrying the valve-punishing "black liquor" give Jenkins Nickel Iron Valves top performance rating.

Jenkins *extra value* construction throughout. Get details — compare. See why they stretch your valve investment dollar — with longer service life, lower maintenance cost.

GET COMPLETE SPECIFICATIONS from your Jenkins Valve Distributor, or write: Jenkins Bros., 100 Park Ave., New York 17. Ask for Bulletin 118.

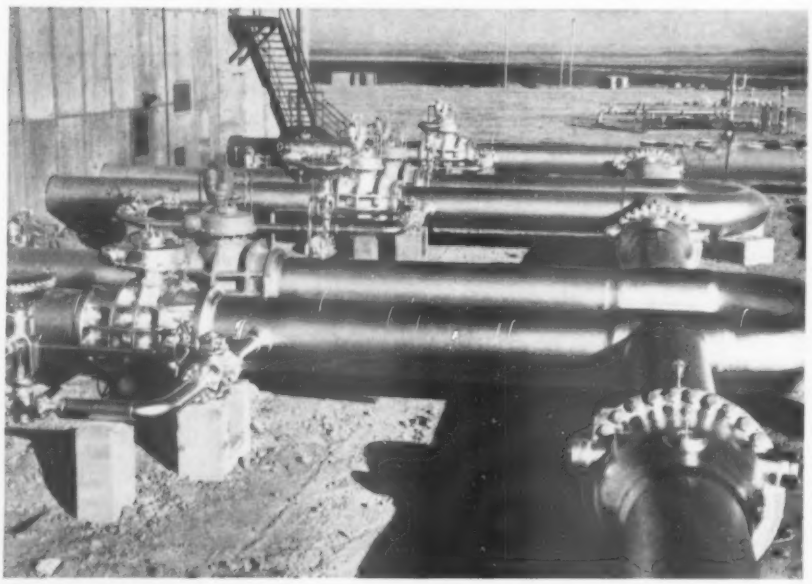
JENKINS
LOOK FOR THE DIAMOND MARK
VALVES
SINCE 1864 TRADE JENKINS MARK
Jenkins Bros.



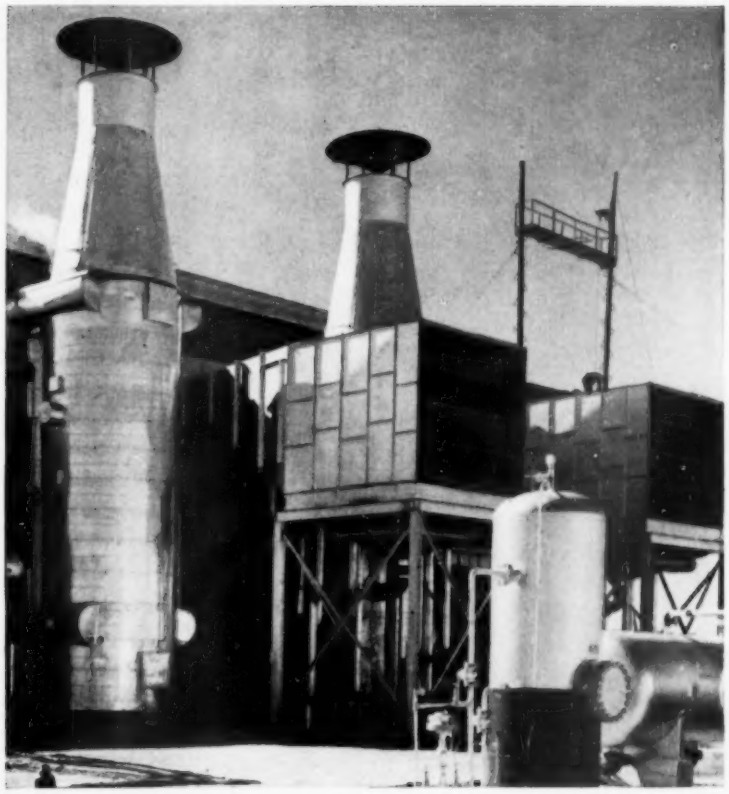
This G-E gas turbine is the first of 28 installed for gas pipeline pumping by the El Paso Natural Gas Co.

El Paso reports performance of G-E

NO OUTSIDE POWER IS NEEDED—panel above provides control for station auxiliaries. Auxiliary generator, driven by the turbine, provides all a-c power while turbine is operating.



MAIN GAS PIPING is simplified by use of gas turbine-driven centrifugal compressors. The suction and discharge valves, purging and pressurizing valves are all controlled automatically on start. The G-E gas turbine is automatically loaded, and the station discharge pressure is maintained automatically.



HIGHER EFFICIENCY—regenerators "recapture" waste heat, enable turbines to pump with efficiencies comparable to other types of power plants.

gas turbines exceeds expectations

Records of first 15 combustion gas turbines used for pipeline pumping show they start fast, save fuel, simplify operation

So far, El Paso Natural Gas Company has put 15 General Electric combustion gas turbines into operation on their cross-country gas line. Performance has been carefully watched. El Paso has found:

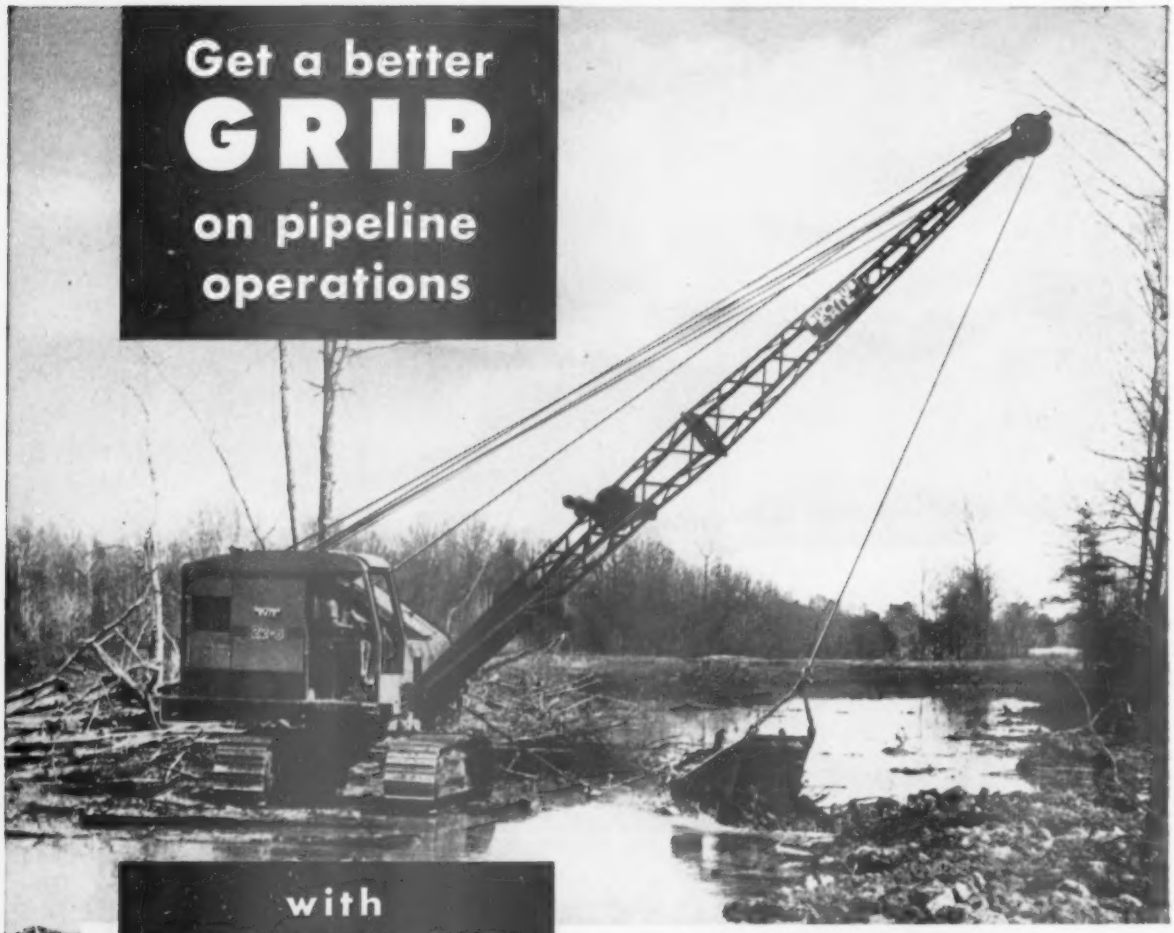
1. **Stations start in 19 minutes—automatically.** Station batteries and pipeline pressures do it all.
2. **Five-man crews can operate stations.** The simple construction of the turbines means reliable performance, easy operation, less maintenance.
3. **Operation proves turbine flexibility.** During nine months of operation under fluctuating conditions, the turbine at Cornudas Station performed with even greater flexibility than had been predicted.
4. **Personnel training system is highly satisfactory.** Key El Paso personnel were sent to the G-E gas turbine plant for intensified training. They in turn trained regular operating staffs. All new positions have been filled by company personnel.

G-E system engineers will be working closely with El Paso engineers during installation of the 13 combustion gas turbines still to go on the line. Your G-E Apparatus Sales Representative can tell you more about their services—and about the G-E gas turbine. Ask him also, to arrange for a showing of the new full-color film, "The El Paso Story," or write to General Electric Company, Schenectady 5, New York. 661-41

Combustion Gas Turbines for the Gas Pipeline Industry—Backed by 45 years of Turbine Leadership

GENERAL ELECTRIC

Get a better GRIP on pipeline operations



This 22-B dragline equipped with tractor-type crawlers is backfilling a submerged pipeline trench in northeastern Texas.

with BUCYRUS-ERIE TRACTOR-TREAD EXCAVATORS

Now, big yardage Bucyrus-Erie 15-B and 22-B excavators are offered with advance design tractor-type crawlers. And these sure-gripping treads are putting the bite on pipeline costs wherever they work. Here's why:

Mobility Across country, over rough terrain, in swamps and creek beds, up banks and high hills — whatever the terrain these new treads give the 15-B and 22-B machines the footing to keep rolling — even up grades as steep as 35 percent.

Strength Back of the new tractor-type crawler is more than ten years of design and field testing. It's a modern, heavy duty tread with big, strong parts that keep going longer on punishing pipeline duty.

Mud No Problem Extra long recoil spring takes the added tension when mud jams into the treads. Open design retards caking of rollers with mud. In addition high axle clearance keeps propelling machinery up and away from mud. Positive seals protect all bearings from dust and grit.

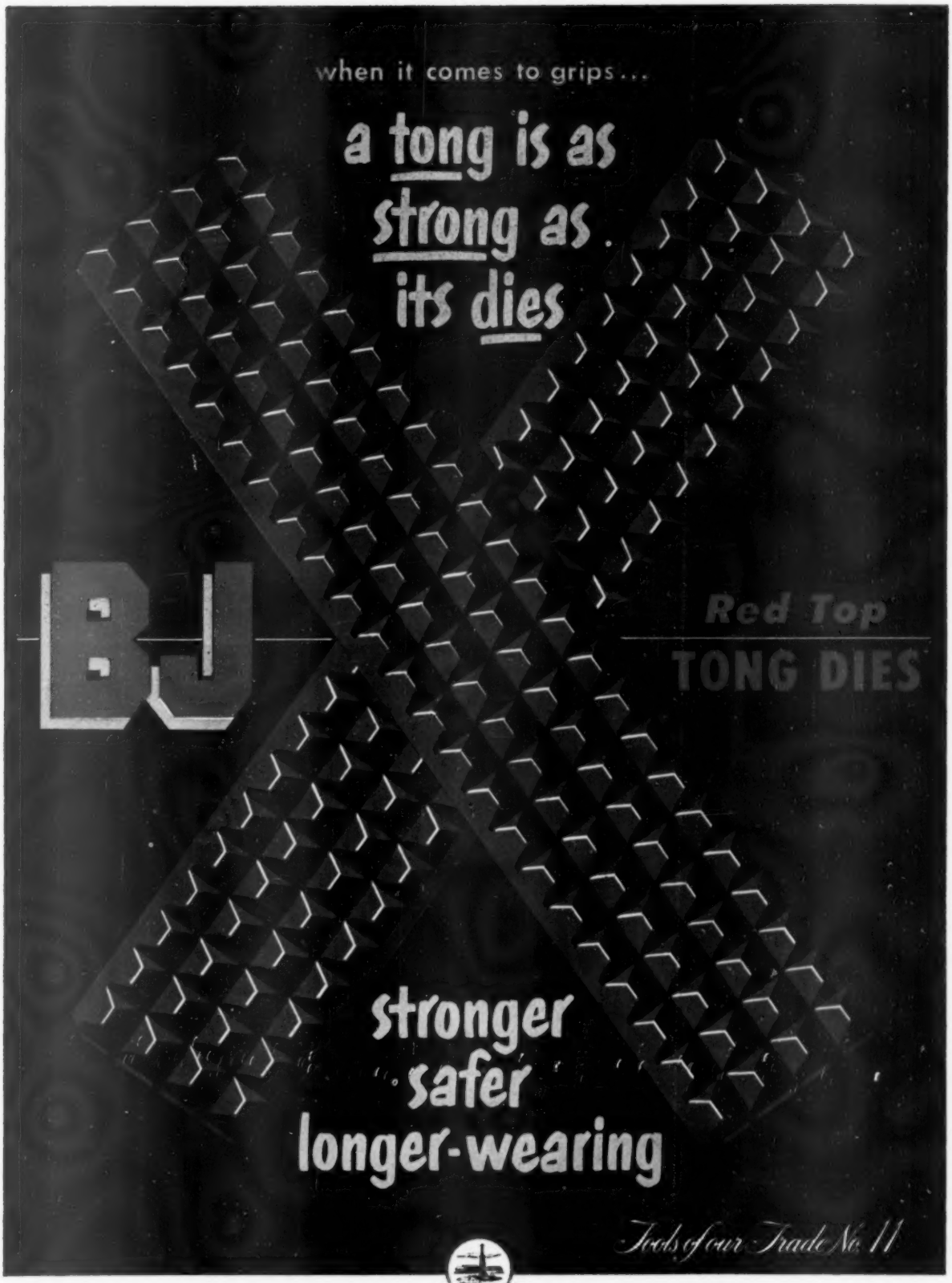
Easier lubrication Lubricated with oil instead of grease, these crawler treads are easier to maintain. Pressure lubrication forces old oil and sediment out of bearings, assuring longer life.

Ask your Bucyrus-Erie distributor for complete information on a 15-B or 22-B dragshovel or dragline equipped with tractor type crawlers. The facts will speak for themselves.

34E53

BUCYRUS ERIE

BUCYRUS-ERIE COMPANY • South Milwaukee, Wisconsin



BJ MEANS ENGINEERED OIL TOOLS

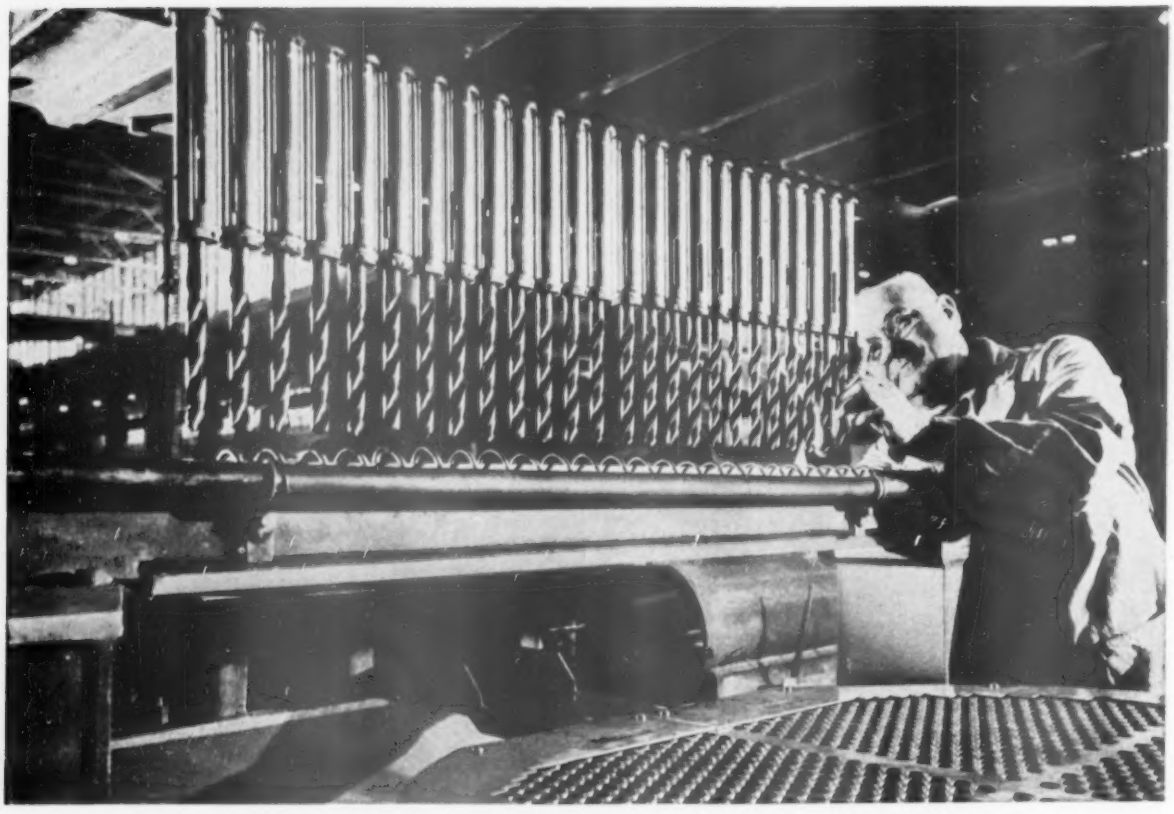
BJ PB

Byron Jackson Co. Since 1872

LOS ANGELES NEW YORK FORT WORTH HOUSTON

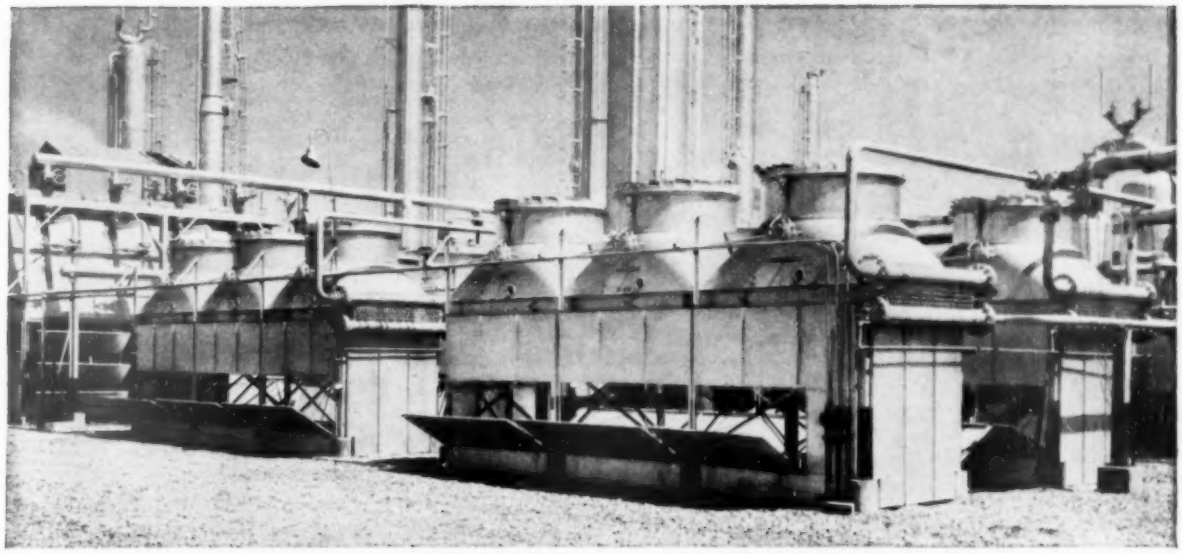
Profit-building answers to Modern

...examples of the wide variety of heavy-metal equipment designed and built by Alco to meet today's demands in petroleum and petrochemical processing . . . results of **Alco Experience** . . . gained through many years of designing and building heavy-metal equipment for refining and processing companies the world over . . . and **Alco Facilities** . . . capable of handling economically an extremely wide range of metal-fabricating operations . . . of meeting strictest customer specifications.

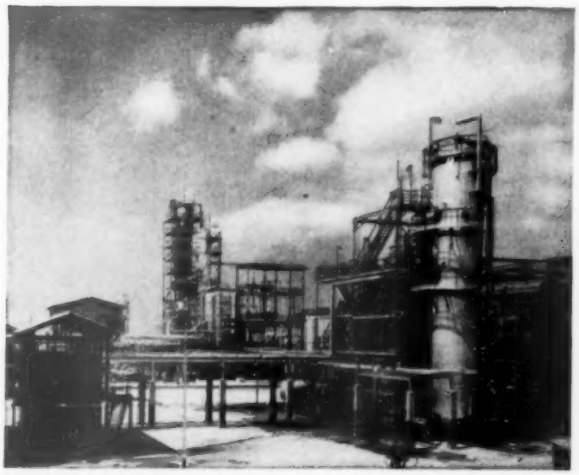


NEW 25 SPINDLE DRILLING MACHINE at Alco's Dunkirk plant typifies the special equipment that enables Alco to produce profit-building answers to almost any processing problem. Spindles take drills up to 1-in. in diameter, pierce steel tube-sheets and support plates up to 4-in. thick at optimum speed.

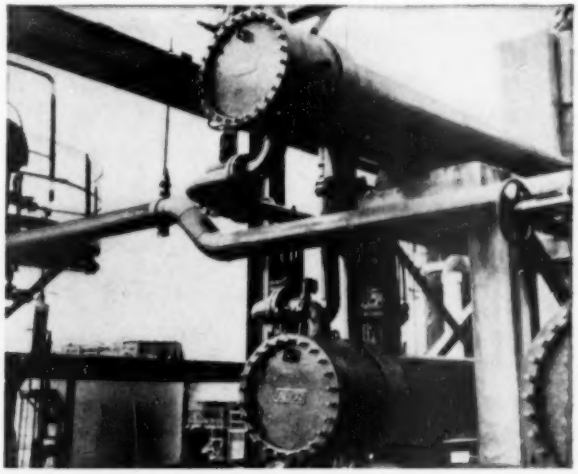
Processing problems



AIRCOOLERS solve the problem of efficient, economical heat dissipation in arid regions. Here, at a Wyoming gas plant, each of two batteries of two specially designed Alco units cools 125,500 lb per hr of lean solution (175 psi, 200 F), at a rate of 4,920,000 Btu per hr—a total of 251,000 lb and 9,840,000 Btu per hr.



AMONG THE MANY ALCO UNITS now in service at Shell Caribbean Petroleum Company's new refinery at Cardon, Venezuela, are the pressed oil flashtower and pressed oil stripper. With a daily capacity of 170,000 bbl, Cardon is the largest refinery on the South American continent.



SPECIAL MONEL CONDENSERS, fabricated by Alco for Atlantic Refining Company's Philadelphia plant, boost efficiency in the manufacture of "Ultrawet" synthetic detergent. Monel construction guards against corrosion by the dilute hydrochloric acid produced in the vapors.

As the first step toward profit-building answers to your own processing problems, contact your nearest Alco Products Sales Representative today. Offices in Dunkirk, New York, Chicago, Los Angeles, Kansas City, Houston, Tulsa, and Beaumont.

ALCO

ALCO PRODUCTS DIVISION

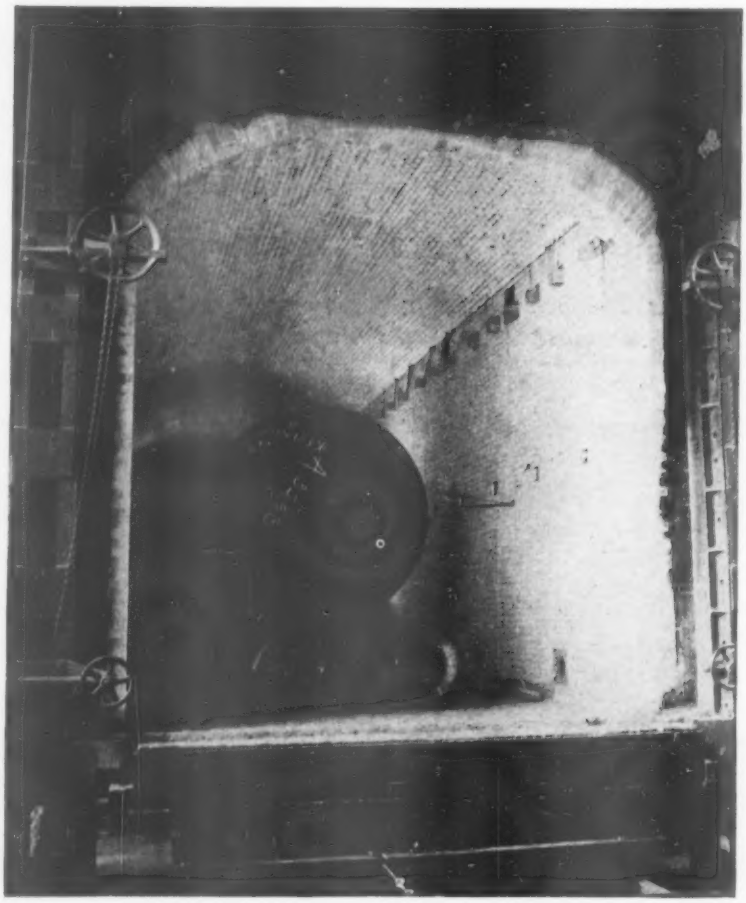
AMERICAN LOCOMOTIVE COMPANY • DUNKIRK, N. Y.

ONLY *COMPLETE* STRESS RELIEF GUARANTEES SAFETY!

Naturally, with more than 50 years of metal fabrication experience behind us, we take every sound step to assure both safety and quality.

Steel tank seams, for example, are first welded then every inch of those seams is x-ray inspected. It is our belief that even this painstaking procedure isn't quite enough! That's why, as a final safety measure, we completely stress relieve each U-68 tank. Only in this way can we offer you a finished product equal to our traditional standards of quality.

If you would like to combine such quality and safety with a reasonable, competitive price why not call in your nearby A.C.F. Representative. It will pay to get *all* the facts before you buy! American Car and Foundry Company, New York · Chicago · St. Louis · Cleveland · Washington · Philadelphia · San Francisco.



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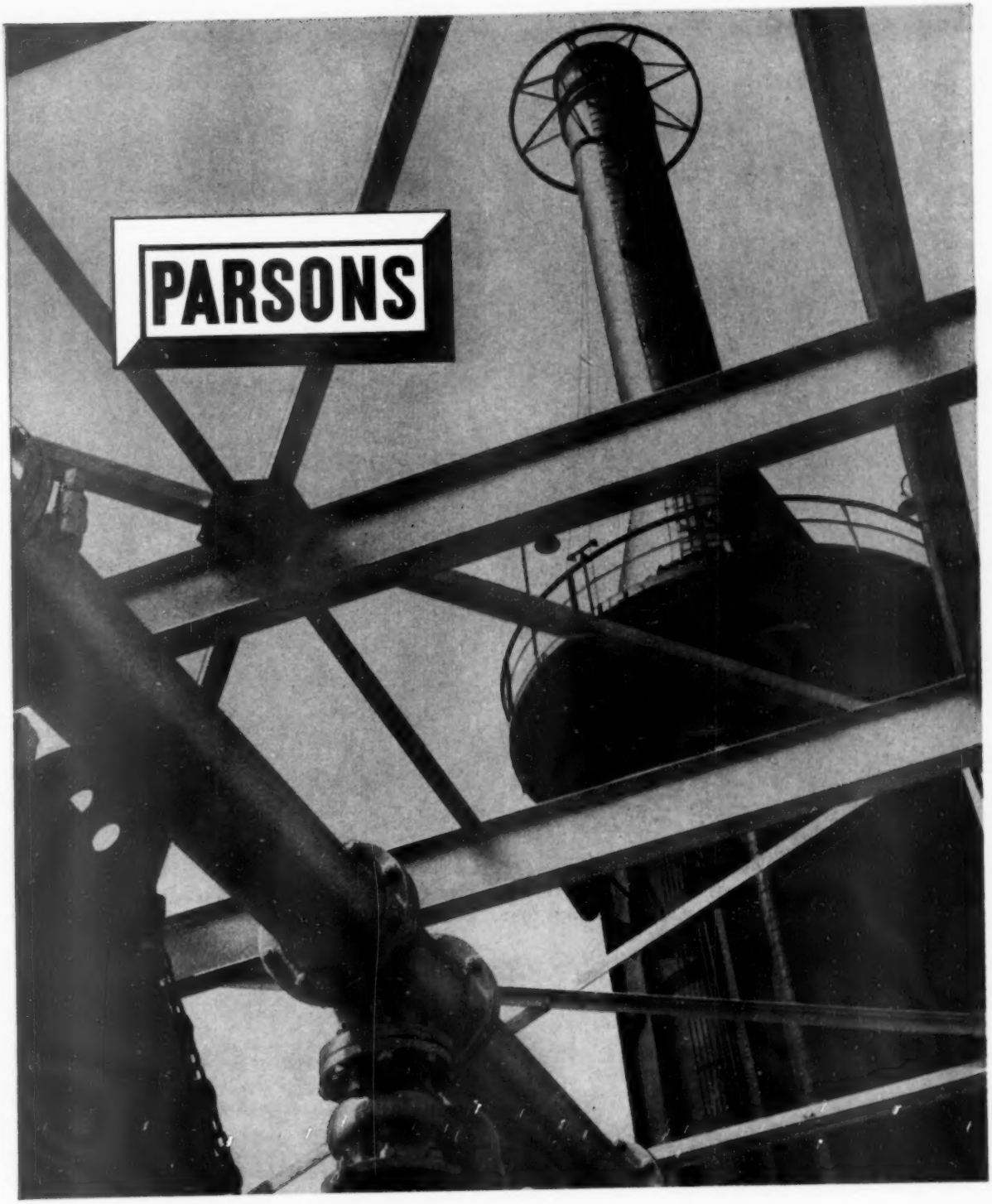

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In less than four years we've shipped more than 22,000 carloads of Basalt-Kaiser Steel line pipe to the nation's growing pipeline networks . . . all of it delivered on time.

This high strength, large diameter pipe of highest quality is playing an important role in the transmission of gas, oil, and water throughout the country.

Experienced pipeline companies know they can rely on Kaiser Steel's uniform quality, prompt service, and wide range of sizes—all good reasons why . . .

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Kaiser Steel

KAISER STEEL PIPE SPECIFICATIONS • All pipe manufactured to latest A.S.T.M. and A.P.I. specifications

Type	Diameter	Length	Wall Thickness	Shipping Point
Continuous Weld—Threaded and Coupled	½" to 4" nominal I.D.	Uniform 21'	Standard	Fontana, Calif.
Continuous Weld—Plain End	2⅜" to 4½" O.D.	Up to 40'	Standard	Fontana, Calif.
Electric Resistance and Fusion Weld—Plain End	14" to 18" O.D.	Up to 40'	.250" to .500"	Napa, Calif.—Basalt-Kaiser
Electric Resistance Weld—Plain End	5⅝" to 12¾" O.D.	Up to 55'	.188" to .375"	Fontana, Calif.
Electric Fusion Weld—Expanded—Plain End	20" to 30" O.D.	Up to 40'	.250" to .500"	Napa, Calif.—Basalt-Kaiser

Prompt, dependable delivery at competitive prices • KAISER STEEL CORPORATION Los Angeles, Oakland, Seattle, Portland, Houston, Tulsa, New York

The man who is never at his desk

The girl who answers the phone for one of Ethyl's automotive engineers must have a pretty frustrating job.

These men are almost never at their desk.

You see, helping bus, truck, and taxi-fleet owners get more efficient operation is not something you can do very well from an office swivel chair. So Ethyl automotive engineers spend the bulk of their time out in the field working closely with oil-company sales and technical people in their contacts with the service managers of fleets.

This offers two important benefits to refiners. Ethyl customers get quick and direct cooperation. At the same time, knowledge gained from direct contact with

(Continued on next page)

ETHYL
ETHYL CORPORATION

Printed in U.S.A.

The man who is never at his desk

(*Continued from preceding page*)

the field enables our laboratory people to keep research directed in the most productive channels.

Our "get out in the field" operation is by no means confined to our automotive men in the field. Engineers from Ethyl's Research Laboratories are constantly at work with farm-tractor people, passenger-car builders, and airplane-engine manufacturers on developments that in the long run may prove important to gasoline refiners and distributors.

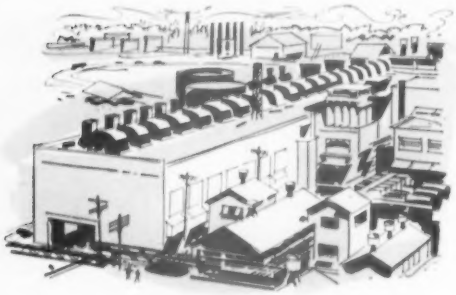
These hours our men spend away from their desks are the most valuable hours. They provide the first-hand knowledge and experience that enable us to give refiners the most effective assistance.

We feel—and we think you'll agree with us—that reliable technical service is an important ingredient in Ethyl antiknock service.

ETHYL CORPORATION

NEW YORK 17, NEW YORK

WORTH NOTING



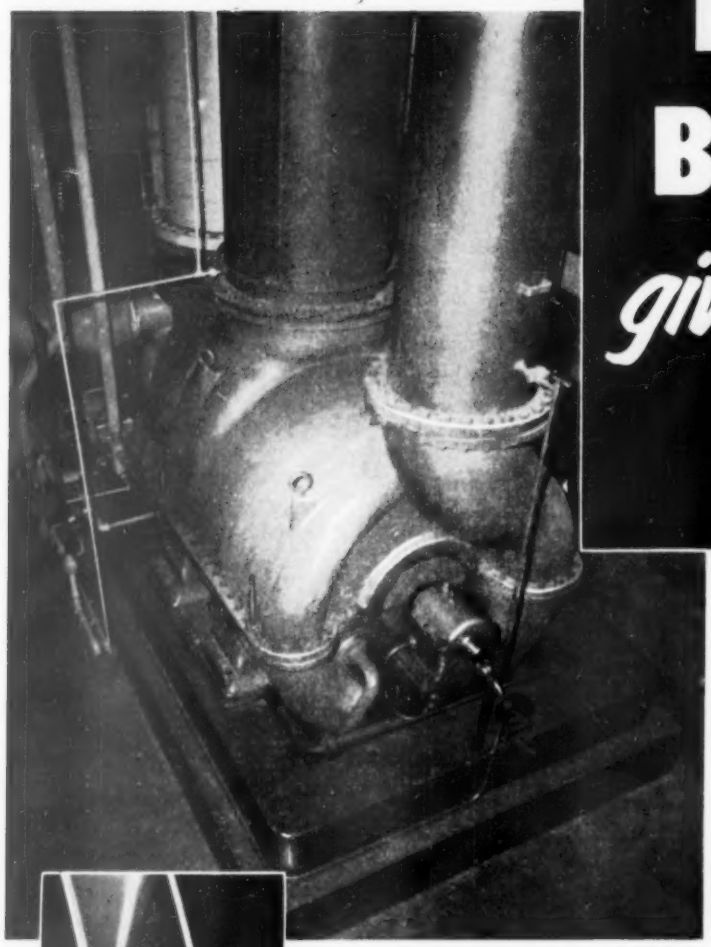
The largest sodium manufacturing facility in the world is part of the huge "Ethyl" antiknock compound plant at Baton Rouge, La.

31 years ago this month, the first sale of "Ethyl" gasoline was made in Dayton, Ohio. Ever since, Ethyl has continuously worked to expand the market for top-quality gasoline.

The "all weather" room at Ethyl's Detroit Research Laboratories can duplicate nearly any temperature, humidity and wind condition encountered in car operation.

Ethyl service is backed by 31 years of antiknock experience

ELLIOTT BLOWERS *give marathon service*



WELDED IMPELLERS *are one of the many reasons why Elliott blowers are getting ever-increasing acceptance for process work. Note the smooth contours, heavy blades, and generally rugged construction (as compared to conventional riveted impellers). These impellers are completely homogeneous and can be made of any weldable material having reasonable mechanical strength.*

CONTINUOUS AND RELIABLE performance is an established characteristic of Elliott centrifugal blowers. This is proven in numerous modern refineries where large quantities of air are required for conveying and regenerating catalyst.

The blower installation pictured is typical. Serving an important midwest refinery, it is rated at 30,000 inlet cfm, compressing air to a discharge pressure of 26 psig. Day and night this blower is driven at 4750 rpm by an Elliott direct-connected 3140-hp condensing steam turbine.

For full details of Elliott blowers, contact your local Elliott representative or write Elliott Company, Jeannette, Pa.

ELLIOTT Company

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CENTRIFUGAL BLOWER DEPARTMENT

P3-6

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carefully . . . expertly . . . intelligently.
We use factory equipment to do the work thoroughly
and speedily, assuring accurate governor performance
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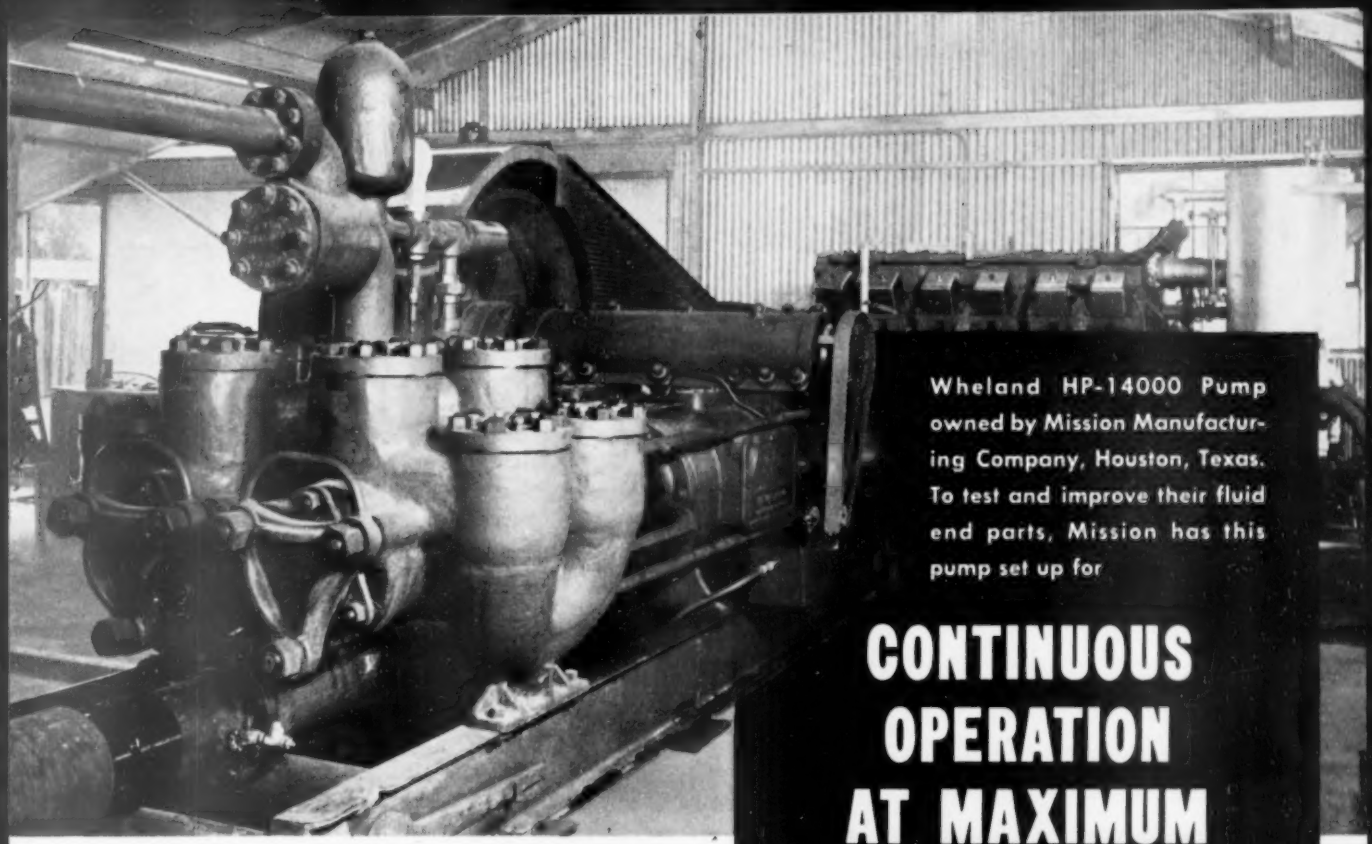

Wheland HP-14000 Pump owned by Mission Manufacturing Company, Houston, Texas. To test and improve their fluid end parts, Mission has this pump set up for

CONTINUOUS OPERATION AT MAXIMUM RATED PRESSURE!

Test conditions are accurately controlled to duplicate field conditions. A standard mud pit, metal tanks, and 130°—140° mud, contaminated with sand and cuttings, are used. Mission keeps careful records of all phases of pump performance. Visitors are welcome to see the test installation and learn the facts about this Wheland HP-14000 Pump.

Because of the high pressures and speeds maintained, this installation should be of special interest to drilling companies planning jet drilling.

WHELAND

HP-14000 7½" x 14"

DUPLEX SLUSH PUMP

350 Horsepower

NOMINAL INPUT AT 60 RPM

Discharge Pressure with 7½" liners 838 PSI
Discharge Pressure with 5½" liners 1627 PSI

WRITE FOR DETAILED BULLETIN

WHELAND

THE WHELAND COMPANY, CHATTANOOGA, TENN., U. S. A.
ROTARY DRILLING MACHINERY

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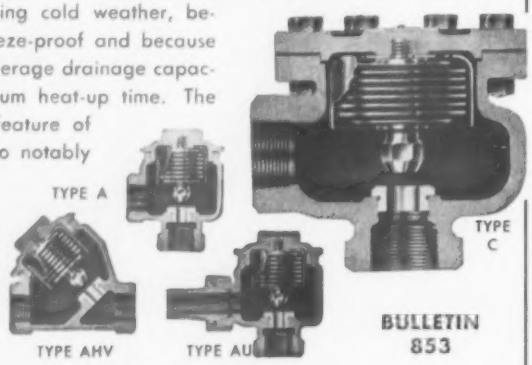
Freeze-Proof Steam Traps

for Every Plant Use

Because they drain completely when cold, these four types of Nicholson steam traps are positively freeze-proof. Can be freely installed outdoors. Universally recommended for use in lines which need not be in continuous use during cold weather, because they are freeze-proof and because their 2 to 6 times average drainage capacity results in minimum heat-up time. The non-air-binding feature of Nicholson traps also notably facilitates heat transfer in severe weather. Types for every plant use. Size ¼" to 2"; pressures to 250 lbs.



BULLETIN 853

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the P&H Line

They Say—

Those Wonderful Statistics

Sir:

Your statistics on oil reserves, gas production, gas reserves, and liquid petroleum were wonderful.

Getting all those statistics compiled must entail a terrific amount of work. But then there is no accounting for what "those Americans" can do.

Raoul Green
Calgary, Alta.
Canada

Misplaced: One Capital

Sir:

Shades of MacKenzie King, look at what some damyankee draftsman did to the capital of our country—Ottawa in Quebec and Montreal in Ontario. *(The Oil and Gas Journal, January 18, page 56).*

Perhaps Canadians aren't entitled to much consideration from the U. S., but when we pay cash (in depreciated U. S. funds) for our subscriptions, we believe you should leave our cities, particularly the capital, where we chose to locate them.

I enjoy your magazine very much, but draw the line at this, even if it did happen to the "East."

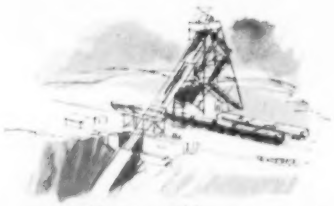
Unsigned Albertan
Calgary, Alta.,
Canada

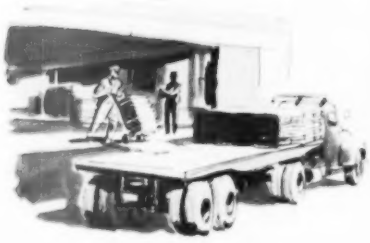
Editor's note: The Journal has no intention of rearranging Canada's geography. In a moment of haste with the paste, our map-making artist slipped and transposed the names. The eagle-eyes on the news desk, whose job it is to notice such things, are apologetic, as is the engraver.

Depletion Bribes?

"According to the aberrant Oregonian (Sen. Wayne Morse), all campaign donations by oil men are bribes—just plain bribes. And those bribes are repaid to the bribe givers by the law that grants a 27½ per cent depletion exemption. From his own premises Morse reasons that the people of Oregon have to pay increased taxes to help pay the oil companies for drilling dry holes in Oklahoma. That is an appealing argument with people who never think and a convincing argument with people who are incapable of thinking.

"Whether this depletion clause is justified or indefensible, it has been the law for about a quarter of a century.





ALL THESE RESOURCES ARE YOURS - FOR EVERY WELL YOU DRILL - FROM MAGCOBAR

What is there about drilling in Wyoming or Canada that's just like putting down a well in Louisiana?

It's true that drilling conditions vary in practically every state . . . and mud requirements with practically every well . . . but there is one "common denominator" in all your drilling operations: Magcobar's vast resources in mines, mills, men and materials are available to you ***wherever*** you drill.

In the past ten years, Magcobar has reinvested a far greater percentage of its income in additional facilities for the oil industry than any other mud company. As a result, Magcobar today is one of the world's largest producers of high quality barite . . . has highly trained mud engineers who serve every drilling area in the United States and Canada . . . a dealer network that keeps your operations supplied night and day.

Yes, all these resources are yours . . . wherever you drill . . . from Magcobar, the pioneer of fair and reasonable prices for drilling muds in the oil industry.

Magcobar

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HOUSTON, TEXAS

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JONES SUCKER RODS

Jones Carbon Type 2 Rod

Here is a sucker rod, the service and quality of which are unexcelled in its field. For medium to heavy pumping loads in non-corrosive fluids, you can't buy a better rod. A very high grade basic open hearth carbon manganese steel is made to experienced alloy practice, fully normalized and shot peened. Machining and processing by modern methods and equipment assure uniform, enduring rod quality. Include Jones Type 2 on your next rod order.

These Balanced Physical Properties Are Obtained Through Carefully Controlled Chemistry

Yield (p.s.i.)	65,000
Ultimate (p.s.i.)	100,000
% Elong. 8"	20.0
% Red. of Area	50.0
Brinell Hardness	200
Charpy Impact	40
Izod Impact	80

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LOOK FOR THE GREEN RODS

No party and no administration has made any serious attempt to repeal it. If Sen. Morse's major premise is correct, then both parties and four or five administrations have been bribed and have paid for favors received with the enactment and retention of an indefensible statute. If the senator's premise is accepted, then the only completely honest man left in public life is Sen. Wayne Morse of Oregon."

Editorial in the Daily Oklahoman, Oklahoma City, Okla.

Venezuelan Trade Consideration

"In a country with a well integrated economy such as the United States the positive contribution Venezuela is making to the over-all prosperity of the country in the form of actual trade (nearly $600,000,000 a year) must be considered very seriously when a decision is reached on the foreign oil debate.

"American management and labor are well aware of the fact that these purchases, for which Venezuela pays cash, are possible because of the United States imports of Venezuelan oil, which provide us with the required dollars. Otherwise, Venezuela would be forced to place its trade with nondollar countries. This actual loss could be more serious to the American economy than the theoretical loss the coal industry attributes to the importation of foreign residual oil."

Delfin Enrique Paez, counsel general of Venezuela, in a letter to the editor of the New York Times.

CALENDAR

FEBRUARY

17-19	Corrosion Control Short Course, fifth annual, Tulsa section of National Association of Corrosion Engineers, Mayo Hotel, Tulsa.
19-20	National Society of Professional Engineers, spring meeting, Hilton Hotel, Albuquerque, N. M.
22	American Association of Petroleum Geologists, Rocky Mountain section, annual meeting, Albuquerque, N. M.
26	Natural Gasoline Association of America, Permian Basin regional meeting, Lincoln Hotel, Odessa, Tex.

MARCH

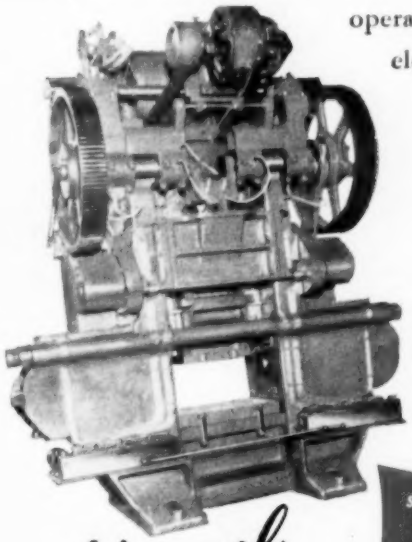
1- 5	American Society for Testing Materials, spring meeting, Shoreham Hotel, Washington, D. C.
3- 5	American Petroleum Institute, Division of Production, Southwestern district, Rice Hotel, Houston.
4- 5	American Gas Association, transmission and storage conference, Jung Hotel, New Orleans.
8-10	American Institute of Chemical Engineers, Statler Hotel, Washington.
15-19	National Association of Corrosion En-

IT COSTS TOO MUCH NOT to have Manzel Lubricated Machinery

Add the cost of:

1. **Breakdowns due to faulty lubrication.**
2. **Wasted oil (Manzel cuts it up to 90%).**
3. **Labor in hand oiling.**

...and you'll agree Manzel Force Feed Lubrication costs *less.* Manzel lubricators are furnished as standard equipment on many leading makes of presses, shears, pumps, engines and other machinery. They can be installed on your present equipment —synchronized by ratchet or direct lever drive, or operated by a separate electric motor.



We will gladly have a Manzel lubrication engineer submit recommendations without obligation. Just write...

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MANNESMANN-EXPORT GMBH DÜSSELDORF

gineers, annual meeting, Municipal Auditorium, Kansas City, Mo.

17-19 American Petroleum Institute, Division of Production, Mid-Continent district, Biltmore Hotel, Oklahoma City.

23-April 1 American Chemical Society, annual meeting, Municipal Auditorium, Kansas City, Mo.

26 American Chemical Society and Sabine Area American Institute of Chemical Engineers, joint session, Beaumont, Tex.

29-31 Western Petroleum Refiners Association, annual meeting, Plaza Hotel, San Antonio, Tex.

APRIL

4- 6 Texas Independent Producers and Royalty Owners Association, Rice Hotel, Houston.

5- 7 American Society of Lubrication Engineers, Netherland-Plaza Hotel, Cincinnati.

6- 8 Petroleum Industry Electrical Association, annual convention and exhibit, Adolphus and Baker Hotels, Dallas.

8- 9 American Petroleum Institute, Division of Production, Rocky Mountain district meeting, Townsend Hotel, Casper, Wyo.

8- 9 Second annual instrumentation conference, Louisiana Polytechnic Institute, Ruston, La.

12-15 American Association of Petroleum Geologists, Society of Exploration Geophysicists, and Society of Economic Paleontologists and Mineralogists, joint annual meeting, Kiel Auditorium, St. Louis.

13-15 Southwestern Gas Measurement Short Course, University of Oklahoma, Norman, Okla.

14-16 National Petroleum Association, fifty-first semiannual meeting, Cleveland Hotel, Cleveland.

21-23 Natural Gasoline Association of America, thirty-third annual convention, Baker Hotel, Dallas.

22 Illinois Oil and Gas Association, annual directors meeting, Hotel Emmerson, Mount Vernon, Ill.

26-28 Southern Gas Association, annual convention, Houston.

MAY

2- 4 Independent Petroleum Association of America, midyear meeting, Cosmopolitan Hotel, Denver.

3- 5 American Geophysical Union, thirty-fifth annual meeting, National Academy of Sciences, Washington, D. C.

3- 5 Air Pollution Control Association, annual meeting, Patten Hotel, Chattanooga, Tenn.

6- 7 American Petroleum Institute, Division of Production, Pacific Coast district meeting, Statler Hotel, Los Angeles.

9-12 Liquefied Petroleum Gas Association, annual convention and trade show, Conrad Hilton Hotel, Chicago.

10-12 Ninth annual Purdue Industrial Waste conference, Purdue Memorial Union, Lafayette, Ind.

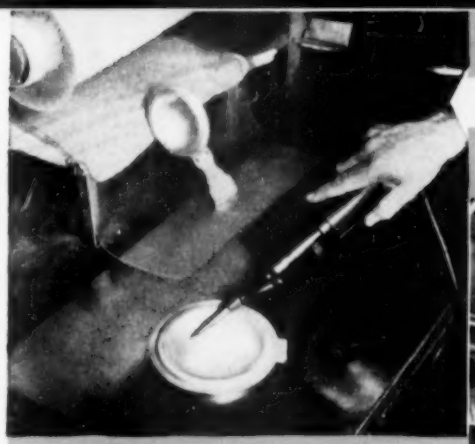
10-12 American Petroleum Institute, Division of Transportation, Products Pipe Line Conference, Warwick Hotel, Philadelphia.

10-13 American Petroleum Institute, Division of Refining, midyear meeting, Rice Hotel, Houston.

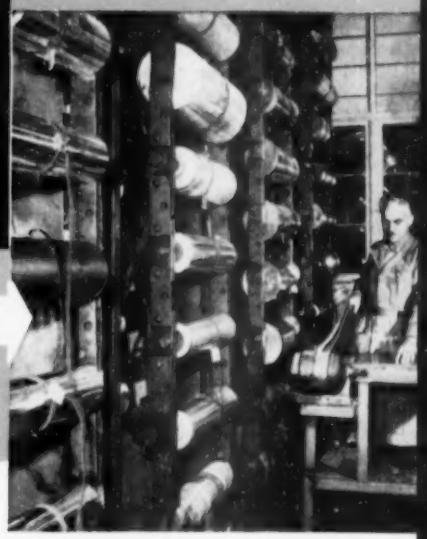
14-15 Interstate Oil Compact Commission, General Oglethorpe Hotel, Savannah, Ga.

16-19 American Institute of Chemical Engineers, Springfield, Mass.

17-19 American Petroleum Institute, Division



Each Kel-F lined rupture disc is given a leak detector test and must be proven pin-hole free.



The large stock of controlled ductile metals used in the manufacture of BS&B rupture discs enables us to duplicate a previous requirement as well as affording you a wide selection in pressures — from 5 to 50,000 lbs.

For CORROSIVE Conditions

Equip Your SAFETY HEADS With BS&B Kel-F Lined Rupture Discs!

Whenever BS&B Safety Heads are installed in a location where corrosive conditions exist, an unprotected metal rupture disc may be vulnerable to corrosive attack from either the product or the atmospheric side—or both.

The recommended disc to use under these circumstances is the BS&B Kel-F lined rupture disc, which has for more than 3 years proven its resistance to corrosive attack from strong acids, caustics, chlorine, etc. Kel-F is a trade name for a thermo-plastic film of trifluorochlorethylene, which is also known by the trade name of Trithene. Discs may be specified with the Kel-F lining on either or both sides, as your conditions may require.

The use of Kel-F linings in combination with metals of known mechanical and metallurgical qualities such as Inconel, Monel, stainless steel, nickel and Hastelloy B means positive, trouble-free protection in highly corrosive applications heretofore impossible.

Thus, through "know-how" attained by years of experience in this highly technical field, BS&B has again provided the Process Industries with a *better* safety device for the protection of closed pressure systems!

For full information on the BS&B Kel-F lined rupture disc and its application to your specific problem, consult your BS&B Office or Representative . . . or write to us direct.

THE "CIRCUIT-BREAKER" OF *Any Pressured System*

BS&B Safety Heads

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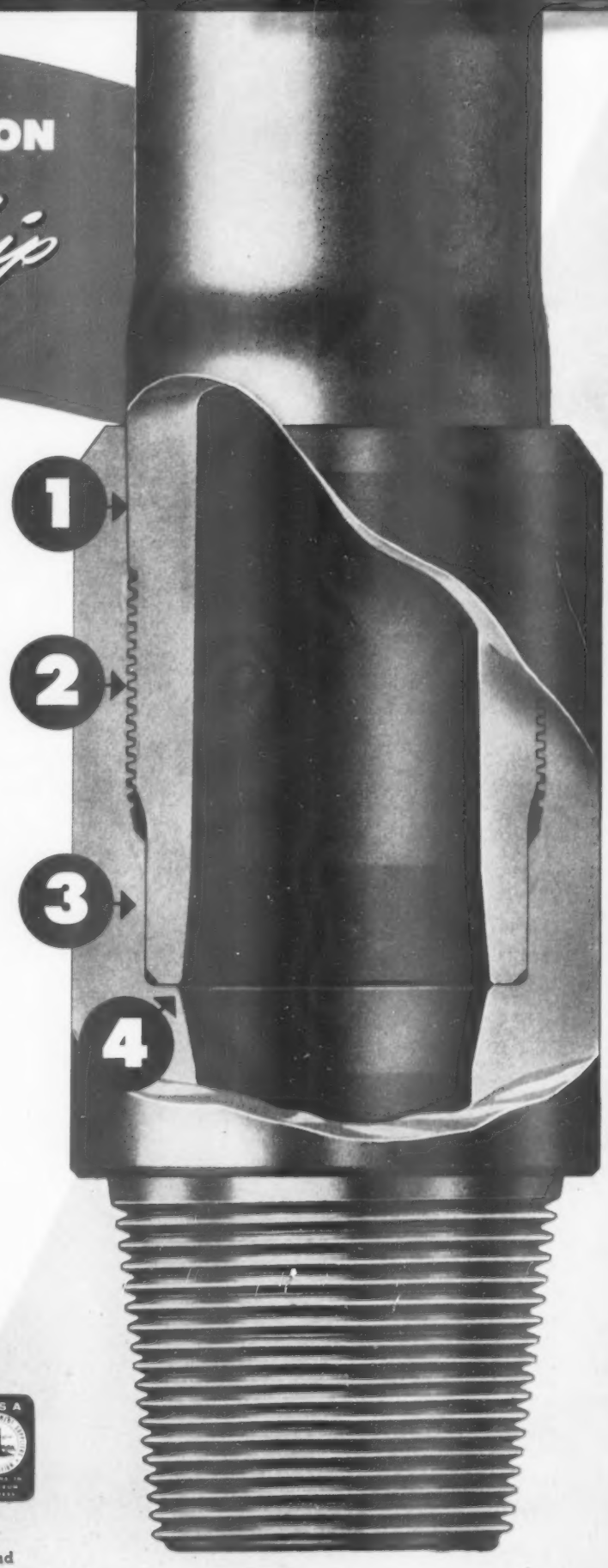

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Use Straight Grip
for positive protection against joint leakage and creep!

Use Straight Grip
for a tighter seal as pump pressures and tension loads increase!

Use Straight Grip
for replacement ease because worn joints can be removed and replaced with new, right at your rig!

Use Straight Grip
for trouble free drilling because of the four points of seal!

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MANUFACTURERS OF A OIL FIELD EQUIPMENT
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OKLAHOMA CITY U.S.A.

PESA

Also manufacturers of "Flash Welded" (welded on) and "Amweld" (counterbore weld) Tool Joints

of Marketing, midyear meeting, Cosmopolitan Hotel, Denver.

24-26 American Gas Association, production and chemical conference, William Penn Hotel, Pittsburgh.

27-28 Natural Gas and Petroleum Association of Canada, Prince Albert Hotel, Windsor, Ont., Canada.

31-June 5 American Petroleum Institute, Division of Production, midyear committee conference, St. Francis Hotel, San Francisco.

JUNE

3- 4 Pennsylvania Grade Crude Oil Association, thirty-first annual meeting, Hotel William Penn, Pittsburgh.

6-11 Society of Automotive Engineers, summer meeting, Ambassador and Ritz-Carlton Hotels, Atlantic City, N. J.

13-18 American Society for Testing Materials, annual meeting and exhibit, Sherman and Morrison Hotels, Chicago.

17-19 American Petroleum Institute, Division of Production, eastern district meeting, Greenbrier Hotel, White Sulphur Springs, W. Va.

20-24 Canadian Gas Association, Banff Springs Hotel, Banff, Alta., Canada.

27

July 1 Petroleum Equipment Suppliers Association, nineteenth annual meeting, Manoir Richelieu, Murray Bay, Que., Canada.

AUGUST

17-19 Society of Automotive Engineers, Inc., international West Coast meeting, Georgia Hotel, Vancouver, B. C., Canada.

SEPTEMBER

9-11 Interstate Oil Compact Commission, Omaha, Neb.

12-16 American Institute of Chemical Engineers, Colorado Hotel, Glenwood Springs, Colo.

15-17 National Petroleum Association, fifty-second annual meeting, Traymore Hotel, Atlantic City, N. J.

28-29 Texas Mid-Continent Oil and Gas Association, annual convention, Baker Hotel, Dallas.

OCTOBER

4-6 Texas Mid-Continent Oil and Gas Association, annual meeting, Plaza Hotel, San Antonio, Tex.

7- 8 California Natural Gasoline Association, twenty-ninth annual fall meeting, Ambassador Hotel, Los Angeles.

11-13 American Gas Association, annual convention, Atlantic City, N. J.

11-13 American Association of Oilwell Drilling Contractors, annual meeting, Biltmore Hotel, Los Angeles.

12-15 Eighth National Chemical Exposition, Chicago Coliseum, Chicago.

14-17 Permian Basin Oil Show, Odessa, Tex.

24-26 Independent Petroleum Association of America, annual membership meeting, Mayo Hotel, Tulsa.

26-27 Society of Automotive Engineers, national diesel engine meeting, Statler Hotel, Cleveland.

NOVEMBER

4-5 Society of Automotive Engineers, national fuels and lubricants meeting, Mayo Hotel, Tulsa.

8-11 American Petroleum Institute, thirty-fourth annual meeting, Conrad Hilton Hotel and Palmer House, Chicago.

28-Dec. 3 American Society of Mechanical Engineers, Statler Hotel, New York.

Count the Features Ponder the Price...

These feature packed unions actually undersell all other similar type unions because they are the only volume produced quick type union on the market.

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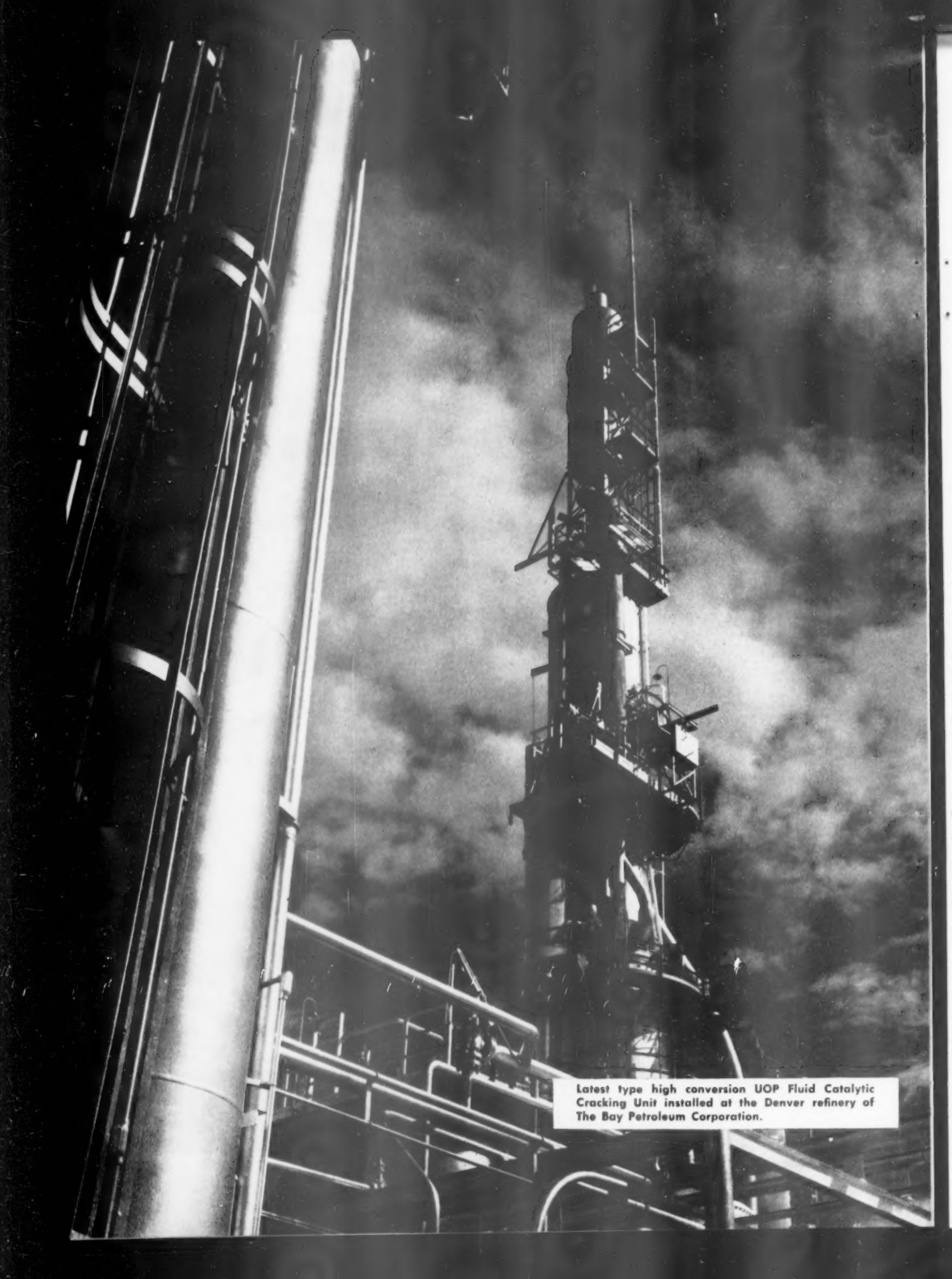

Latest type high conversion UOP Fluid Catalytic Cracking Unit installed at the Denver refinery of The Bay Petroleum Corporation.

MODERNIZATION PROGRAM AT BAY DENVER NEARLY DOUBLES CRUDE CAPACITY

By C. O. Garbrecht, Vice-President
The Bay Petroleum Corporation

A sweeping modernization and expansion program completed at a cost of several million dollars at our Denver refinery has enabled it to nearly double its crude capacity while at the same time substantially increasing the overall yield of refined products and greatly improving the quality of those products.

C. O. Garbrecht

Our program, which made the refinery at Denver one of the largest in the Rocky Mountain region, was centered around the installation of the latest type high conversion Fluid Catalytic Cracking unit designed by Universal Oil Products Company. The unit has a design capacity of 3,528 barrels per day of fresh feed stock at 76 per cent conversion. The design coke burning capacity is 3,770 pounds per hour.

Coincidental with construction of the cat cracker the Dubbs thermal cracking unit was converted into a visbreaker-vacuum unit for preparation of cat cracker feed stock. A crude topping unit, gas concentration plant, and a polymerization unit also were redesigned, enabling us to make the maximum use of existing refinery equipment.

Universal Oil Products Company designed and engineered the new cat cracker and redesigned existing equipment, while all construction work was handled by Procon Incorporated.

Crude Capacity 11,000 Bbls.

Through these changes, our refinery at Denver which previously processed 6,000 barrels of crude oil daily now handles 11,000 barrels daily, and it is marketing a premium gasoline which is specifically tailored to meet the requirements of high altitude driving.

In our modernized refinery operation, the converted crude unit processes a blend of Wilson Creek, Wellington, and Lance Creek crude oils. A light straight run gasoline, naphtha, kerosene, Diesel fuel, gas oil and reduced crude are prepared from this blend. The latter material forms the charge to the visbreaker-vacuum unit.

Charge to the visbreaker is cracked lightly on a once-through basis before being discharged into a flash chamber. Vapors which are formed there are fractionated into a gas and gasoline overhead and gas oil bottoms. The gas and gasoline are sent to the cat cracker gas concentration unit for further separation and recovery.

After being heat exchanged against crude and then cooled, gas oil bottoms are sent to storage, where they are picked up along with other gas oil streams. The mixture comprises the feed stock for the cat cracking unit.

Bottoms from the visbreaker flash chamber are vacuum flashed in another tower. Vacuum gas oil is condensed and sent to storage as part of the cat cracker charge stock, while visbroken and vacuum flashed pitch is cut back with cat cracker cycle oil to meet No. 6 fuel oil specifications.

Gas and gasoline produced in the cat cracker undergo further processing in the gas concentration plant, which prepares feed for the revamped poly plant, as well as debutanized gasoline. Excess light gases are vented to the refinery fuel system.

Recoveries Run High.

Recoveries of light end materials from the gas concentration system have been found to be exceptionally high, averaging more than 85 per cent on the propane-propylene fraction and nearly 100 per cent on the butane-butylenes.

The gas concentration unit is divided into four sections—a primary absorber, a secondary absorber, a stripper and a debutanizer. Low pressure gas, from the cat cracker receiver is supplied to the primary absorber. Condensate in the cat cracker receiver is the absorption medium for this column.

Gas from the primary absorber is sent to the secondary absorber, whose absorption medium is cycle oil from the cat cracker fractionator. Primary absorber bottoms are stripped before being debutanized. Debutanizer overhead is charged to the revamped poly plant, while debutanizer bottoms are sent to cat cracked gasoline storage.

Idle Equipment Used.

Effluent from the poly plant is used as part of the unit's recycle. Because additional heat exchange was needed due to the increase in crude capacity, finned tube sections removed from idle units in the refinery were added to the poly plant.

The poly plant's effluent is depropanized. The net overhead is charged to a de-ethanizer, where LPG is prepared as a bottoms cut.

Depropanized polymer is stripped and excess butane is removed overhead. A 10-pound polymer is produced as a bottoms fraction.

We feel that the constantly increasing demand for our new cat cracked products more than justifies the expenditures we made in modernizing this refinery and making it the finest in Rocky Mountain Area.

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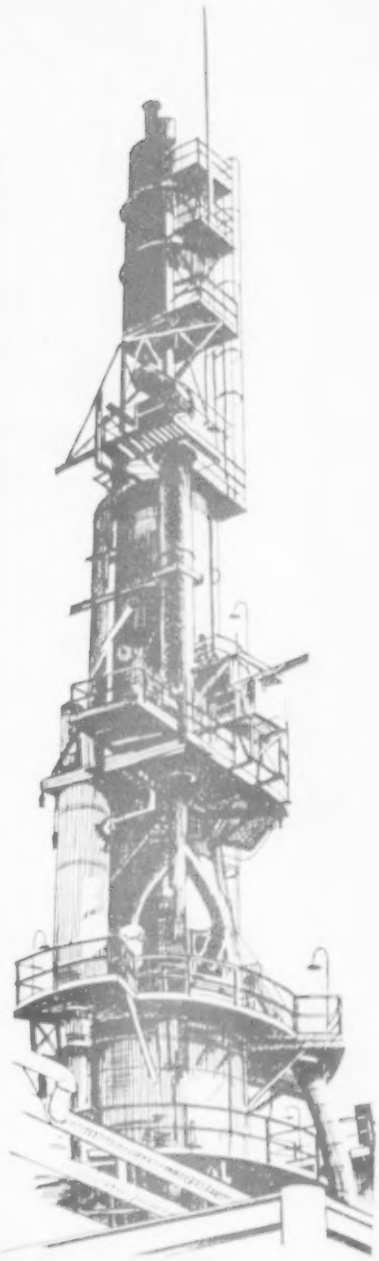

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THE OIL AND GAS

JOURNAL

TULSA, OKLAHOMA

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JOURNALLY Speaking

The Incubator

AMAZING "firsts" keep cropping up in this amazing oil business. Now we have a report of the first cat cracker to hatch an egg—not lay an egg, hatch one.

The achievement belongs to the Aruba refinery of Lago Oil & Transport, Ltd. An employe brought an egg to work, intending to cook it later, but put it in his locker and forgot about it. The locker was in the control room of the cracking unit where the temperature was about 80° F. day and night. Three weeks later he looked for the egg and found a chick instead. This created such excitement that the Lago Vocational School put the chick up as a prize in an essay contest which was won by a 15-year-old boy who wrote that he intended to start a flock and become the chicken king of Aruba. Unfortunately, the chick died just before the presentation, but Lago donated another so that the lad could start his adventure in free enterprise—all in the spirit of enlightened capitalism.

Big Spring Hero

AN unassuming young geologist has quietly returned to his job with Cosden Petroleum Corp. after an absence of 2 years which he doesn't talk about much. But everybody in Big Spring, Tex., and everybody in the U. S. Marine Corps knows about it and talks about it. And President Eisenhower talked about it in the White House last October when he hung the Congressional Medal of Honor around the neck of Lt. George H. O'Brien, Jr.

The citation which the President read told how, in October 1952, Lieutenant O'Brien and his company of Marines in the front lines in Korea were subjected to a massive barrage from 12 battalions of Chinese artillery firing 7,500 rounds per hour. The disorganized company was discussing retreat when O'Brien leaped out into no-man's land yelling to his men to act like Marines and follow him in a charge on the enemy battery. He was shot through the right arm and knocked down three times by mortar fire, but grenades and his bayonet wielded by his left hand sent several Chinese to join their ancestors. His company captured an enemy hill and held it all night until relieved, after which O'Brien evacuated his wounded before consenting to medical attention for himself.

"His indomitable determination and valiant fighting spirit reflect the highest credit upon himself and enhance the finest traditions of the United States Naval Service," the citation concluded.

Now George O'Brien is back with Cosden and his family in Big Spring, and, we are proud to say, has resumed his reading of our favorite oil publication. We predict that if he goes after oil the way he went after the enemy he will continue to reflect the highest credit upon himself and enhance the finest traditions of the oil industry.

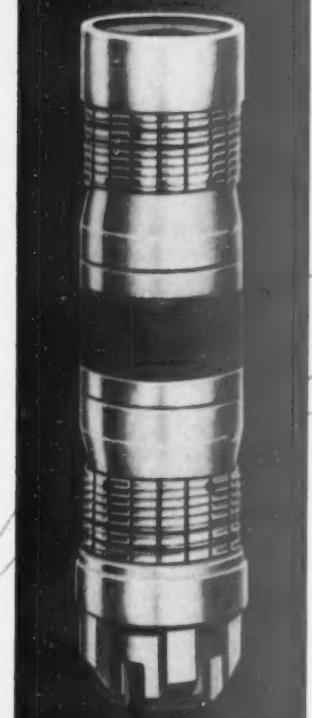
Notes From All Over

PEOPLE keep sending us clippings relating odd bits and sidelights of this far-flung petroleum industry. We'll pass on a few, boiled down.

One tells about a well-dressed Negro who found a New York theater closed and inquired of the watchman about the former proprietor; said if the proprietor needed any help he'd be glad to stake him; revealed that he was janitor there before the war; after V-J Day he invested his Army pay in an oil venture; now worth millions. If true—and we have no reason to doubt it—this rags-to-riches story shows there's still money to be made in the oil business and that Lady Luck is still hovering about.

At the other extreme, a clipping tells about how a new synthetic chemical made from petroleum has proved to be such a superior insulator that submarine telegraph cable covered with it weighs and costs one-third less than the old kind, and through its use transatlantic cable service has just been restored between Italy and South America after the old cable was cut during the war. Shows how science is extending petroleum's usefulness to mankind.

—*Henry D. Ralph.*



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BAKER BRIDGE PLUG

Going underground is good for gas

THE gas industry is going underground as fast as it can in a movement which promises to solve one of its biggest problems and also be a boon to both producers and household consumers.

It is putting gas back into the ground—but where it is needed instead of where it happened to be found. Dealers in gas are learning to do what dealers in other seasonal commodities have been doing since the dawn of history—store it in the summer when it isn't needed so as to have plenty in the winter when it is.

Large-scale storage of natural gas near consuming areas is almost entirely a postwar development. Ironically, it was only after some costly experiments with man-made containers that it dawned on gas men to use the type of reservoir that nature has used for millions of years—porous rock capped with an impervious stratum.

NOW the search is intense for suitable geologic structures. Since the war the industry has developed more than 150 major storage fields and increased storage capacity more than 1,000 per cent.

The most profitable market for natural gas is residential heating. It is also the fastest-growing market, the one with the greatest potential for future growth, and the one least vulnerable to competition or a general business depression. But it is purely a seasonal market, and it is uneconomic to build transmission lines big enough to serve the coldest days and maintain them largely idle during much of the year.

Until storage came along, the only practical solution was to make summertime "dump" sales of gas to industries for boiler fuel, subject to interruption at any time. Such sales bring a low price, and this "inferior" use of a superior fuel causes much criticism and from time to time brings threats of federal regulation of the end use of gas.

THE ideal way out of this dilemma is to store enough gas in consuming areas in the summer to take care of the peak demand in the winter, and keep the system going steadily the year around with all gas going ultimately to preferred customers. A few transmission companies are already about halfway to this goal, and one or two expect to reach it within a few years.

This storage is not cheap. The industry has invested some $250,000,000 in underground storage and may double this figure in the next 5 years. But this happy blending of economics and geology should pay off handsomely to everyone except users of cheap dump gas.

Householders will be assured of a bigger share of the nation's gas supply. Earnings of pipe-line companies will go up without a proportionate increase in residential rates. This should result in higher field prices to gas producers, thus stimulating conservation and the development of new reserves. This underground movement is a good deal all around.

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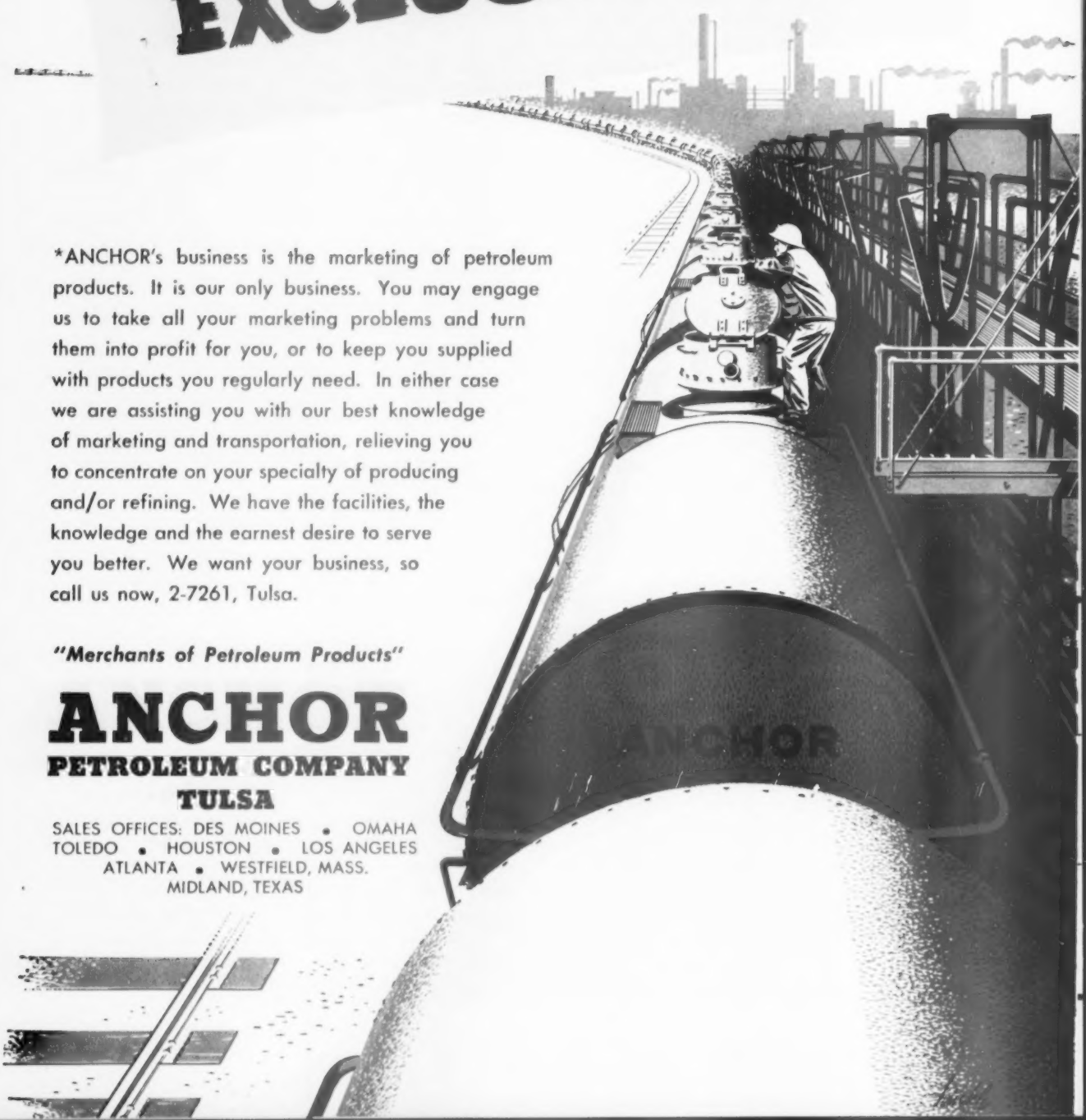


THIS WEEK... ...IN THE NEWS

NEARING BOTTOM last week was this rank wildcat of Gulf Oil Corp. and Northern Pacific Railway Co. in the Trotters area of Golden Valley County, North Dakota. The remote test, projected to the Cambrian at 13,000 ft., was drilling at about 12,300 ft. The wildcat was spudded in January a year ago and has had several shows of oil and gas on the way down. It is 18 miles east of the Montana border and 28 miles northwest of the Fryburg field in Billings County, North Dakota.

INTERNATIONAL—Conorada is expected to begin immediately on a long-range program of exploration on its 75,000-sq.-mile Egyptian concession. . . . ¶A party of 20 representatives of British and American oil companies tours Iranian oil fields and the Abadan refinery to determine how much is involved in resuming operations. . . . ¶Iraq Petroleum is considering diverting its unused Haifa pipe line to skirt Israel to a terminal on the Lebanese coast. . . . ¶Australian operators plan additional tests to follow Rough Range discovery. . . . ¶Ground-breaking ceremonies for Puerto Rico's $11,000,000 refinery scheduled for February 15. . . .

GOVERNMENT—Texas prepares alternate proposals to tax natural gas immediately following U. S. Supreme Court decision striking down the Texas "gas gathering" tax. . . . ¶Arkansas Supreme Court rules the state has no law providing for the purchase of oil and gas rights at county sales held as a result of nonpayment of taxes. . . . ¶Interior Department issues general rules for development of Continental Shelf lands. . . . Industry is asked to submit written comments, suggestions or objections. . . .

INDUSTRY—Growth of integrated operations in oil industry due directly to strong competition between companies, Harvard Business School study concludes. . . . Easy profits would provide no incentive toward integration. . . . ¶Gulf licenses Tulsa firm to manufacture new pipe-line interface detector. . . . ¶World's largest tanker launched. . . . Ship, to be chartered to Gulf Oil Corp., has capacity of about 393,000 bbl., will operate between East Coast and Middle East. . . . ¶First survey of public attitude toward oil industry in 3 years shows there's been some improvement, but there's still a long way to go. . . .

PIPE LINES—American Pipe Line Co. proposed to ODM that it build a 24-26-in. defense line parallel to its own planned line from Texas to the East Coast with U. S. advancing $60,000,000 as half construction cost of the line. . . . ¶Heavy equipment, materials and supplies arrive at Fairbanks as contractors get ready for first break of winter to begin work on Alaskan defense products line. . . .

ACTIVITY—Production of crude and lease condensate averaged 6,284,450 bbl. daily for week ended February 6, up 14,150 bbl. daily. . . . Total wells completed for the week dropped 141 wells to 905. . . . Wildcat completions increased 4 wells to 196. . . . Rotary rigs operating in the United States totaled 2,504 rigs on February 8, up 43 for the week. . . .

TRENDS—Refinery runs for week ended February 6 averaged 95,000 bbl. daily less than for the four preceding weeks. . . . Gasoline production was up 23,000 bbl. daily over the 4-week average. . . . Weekly production of gasoline has exceeded 25,000,000 bbl. for only 5 weeks in oil history, but two of the record weeks were in the past 2 months. . . .

Gathering Tax Killed

Supreme Court unanimously rules Texas law invalid, but hints gas could be taxed constitutionally at earlier stage

Bertram F. Linz

WASHINGTON.—The Supreme Court last week unanimously held the Texas "natural-gas-gathering" tax invalid as an unconstitutional burden on interstate commerce.

But in its opinion, delivered by Justice Tom C. Clark, the court appeared to suggest that the state might substitute a tax on processing.

Clark pointed out that the tax was levied on the taking of gas into interstate commerce after production, gathering, and processing, "but the processing, on which this tax is not imposed," took place prior to the "taking."

Some observers saw in Clark's comment a hint of the point at which it may hold Federal Power Commission jurisdiction stops, when it considers the Phillips Petroleum Co. case. That case, which the court announced last month it would review, involves the question of FPC jurisdiction over Phillips' gas operations and many have seen in the decision of the District of Columbia Court of Appeals a suggestion that its authority should begin with, or possibly prior to, the receipt of gas at processing plants.

Clark also philosophized that, if upheld, the gathering tax could conceivably have set off a chain reaction, with every state through which a pipe line passes or in which gas was delivered levying its own impost.

Background . . . The court's action ended more than 2 years of controversy and paved the way for return to some 120 pipe-line companies of close to $25,000,000 already collected through the tax.

The tax of 0.45 cent per 1,000 cu. ft. upon the "taking" of residue gas at the outlets of gasoline plants was put into effect in September 1951.

The levy was immediately contested by a number of companies and out of 119 suits brought to test its constitutionality, those of Michigan-Wisconsin Pipe Line Co. and Panhandle Eastern Pipe Line Co. were carried through the Texas courts to the state Supreme Court, which held it valid, and then to the nation's highest tribunal.

What the court said . . . In its decision last week, the Supreme Court accepted the contention of the companies that the taking of possession of the gas is an integral part of a continuous process culminating in its transport out of Texas to markets in other states. It ruled that a tax on any part of that process, therefore, is a tax on interstate transportation in violation of the commerce clause of the Constitution.

Conversely, the court did not agree with the argument of the state that the tax was justified as compensation for measures taken to protect the gas supply of the pipe-line companies.

The tax here assailed applies equally to gas moving in intrastate and interstate commerce," Clark said. "It is levied in addition to all other licenses and taxes and is denominated an occupation tax for the privilege of engaging in the 'gathering of gas.' Obviously appellants are not engaged in 'gathering gas' within the meaning of that term in its ordinary usage; but the tax statute gives the term a transcendent scope; as to appellants' operations it is defined as 'the first taking . . . of possession of such gas for other processing or transmission . . . after such gas has passed through the outlet' of a gasoline plant."

"The problem in this case is not whether the state could tax the actual gathering of all gas whether transmitted in interstate commerce or not, but whether here the state has delayed the incidence of the tax beyond the step where production and processing have ceased and transmission in interstate commerce has begun," Clark said at another point.

"The 'taking' into appellants' pipe lines is solely for interstate transmission and the gas at that time is not only actually committed to but is moving in interstate commerce. What Texas seeks to tax is, therefore, more than merely the loading of an interstate carrier."

"The privilege taxed, namely the taking of the gas, is not so separate and distinct from interstate transportation as to support the tax," the court ruled. "But additional objection is present if the tax be upheld. It would 'permit a multiple burden upon that commerce,' for if Texas may impose this 'first taking' tax measured by the total volume of gas so taken, then Michigan and the other recipient states have at least equal right to tax the first taking or 'unloading' from the pipe line of the same gas when it arrives for distribution. Oklahoma might then seek to tax the first taking of the gas as it crossed into that state. The net effect would be substantially to resurrect the customs barriers which the commerce clause was designed to eliminate."

A review of the case appeared in The Oil and Gas Journal, June 15, 1953, page 80.

Texas to Try Again

Officials ready with alternate proposals to replace lost tax funds, earmarked to boost salaries of state teachers

Robert J. Enright

AUSTIN.—Texas state officials are wasting no time in a search for legislation to replace the $14,000,000 annually snatched from the state treasury by the "gas gathering" tax.

The pressure is on here in the state capital for the lost money and more, since revenue over and above that brought in by the gas tax is needed to still the clamor for a $400 pay boost annually for each of Texas' 63,000 school teachers.

It is apparent that the legislators, who have been put in the embarrassing position of trying to raise a big chunk of cash by taxation in an election year, are going to be considerably more cautious in drafting and passing the next revenue-raising bill.

An effort will be made this time to pass a bill which, not only won't be invalidated by court action but is unlikely to be contested in court—just about as bad from the state viewpoint since needed money is untouchable until such action is settled.

New revenue proposals . . . A welter of alternative measures already have been proposed, and a large number of them probably will be considered at a special session of the legislature called by Gov. Allen Shivers for March 15.

Consensus is that the proposals advanced by Atty. Gen. John Ben Shepperd, drafted some time ago in anticipation of the Supreme Court's action, are among the best.

In regard to his proposals, Shepperd had this to say:

"If the people and the legislature want to place a tax on natural gas, it could be done in a legal manner, even under today's (February 8) decision by the court.

"Anticipating the court's decision, my office has worked on methods whereby a state levy could be laid on the same gas taxed under the previous statute and not be successfully attacked in court . . . our research has established that a production tax is unquestionably valid.

"The gas-production tax can be amended so as to increase the production tax on residue gas. Our waste statute could be amended so that it will constitute waste for a producer of gas to fail to pass the gas-production tax on to the purchaser. As a conservation measure, this amendment is clearly valid under a recent holding of the Supreme Court of the United States.

"In the event such a statute is contested, a precautionary, standby statute would be a minimum price law to take effect only in the event the waste statute is held invalid."

The Shepperd bills . . . Shepperd released the text of three proposed bills, any of which it is believed would more than replace the gathering tax, revenue-wise. Briefly their provisions are:

. . . Production tax on natural gas, now at 5.72 per cent of market value, would be increased to 1.5 cents per M.c.f. The tax on liquid hydrocarbons extracted from the gas by mechanical and nonmechanical means would remain the same at 4.6 and 5.72 cents per M.c.f., respectively.

The measure would exempt that gas used for pressure maintenance, gas lift, and other such operations, that produced with oil and lawfully flared or vented, and that produced from underground storage. The bill would bring in an estimated $50,000,000 annually.

. . . Present gas-waste law would be amended to make it a waste of gas for a producer to fail to pass the production tax along to the purchaser, if the gas price paid the producer, tax included, is less than 10 cents per M.c.f.

. . . A "standby" bill would be used only if the gas-waste law were ruled invalid. It sets the state-wide minimum price for a M.c.f. of gas with 1,000 or more B.t.u. at 10 cents.

It would exempt that gas: (1) Injected for pressure maintenance, repressuring, and other such purposes, (2) used as fuel in drilling or producing oil or gas wells, (3) produced at a lesser price by permission of the Texas Railroad Commission due to its low quality, remoteness from market or pipe line, low pressure, small volume, etc.

All of the above proposed bills contain a clause which, by reason of a declared emergency, dispenses with the constitutional rule requiring bills to be read on three separate days before each house. The standby bill contains a clause to the effect that the entire bill shall not be invalidated if a section, article, or other part is subsequently held invalid or unconstitutional.

Reserves angle . . . The problem was attacked from another direction by Rep. George Hinson, of Mineola, a leader of the gas-tax block in the House, who is backing a 1-cent per M.c.f. tax on dedicated reserves of natural gas.

A bill which would accomplish this was sponsored by Hinson in the last session of the legislature. Official estimates by the comptroller's office then, Hinson said, were that such a tax would raise $37,000,000 annually.

The Supreme Court decision leaves the way wide open for such a tax, Hinson said. "This does not tax gas in transit. This is a tax to be paid by the beneficial owners of natural gas—and the beneficial owners are the pipe lines which purchase the gas on contracts of 1 year or more. . . This dedication tax is levied before the gas ever comes out of the well, and there can be no question but that the gas is not in interstate commerce. . . ."

Hinson said he is sending copies of the bill to Governor Shivers, Shepperd, Speaker Senterfitt, and Lt. Gov. Ramsey and asking them to back the measure as "logical answer to Texas' serious tax problem."

Fight to continue . . . It is obvious from these proposed bills and others that the state feels the producer is carrying his share of the tax load and that the interstate pipe line is not. It is equally obvious that the state isn't about to abandon its efforts to remedy this situation and that the gas interests, with strong legislative backing, won't give in to even-heavier taxation early.

It is not yet certain that the extended battle over the gathering tax is ended. Shepperd said in a statement February 8 the state "probably" will file a motion for a rehearing in the case. The Supreme Court, however, will be in spring recess until March 8, and would not have opportunity to hear the motion before that time.

Duster Becomes Discovery

MIDLAND.—Fracture treatment of an old dry hole in southwestern Borden County has resulted in a new field discovery.

J. E. Jones Drilling Co. recompleted the 2 Miller as a flowing well from the lower Spraberry formation. The well originally was drilled by Blanco Oil Co. et al to 8,561 and finished as a dry hole.

The new operators plugged back to 7,462 ft. and perforated the sand at the 7,105-25 and 7,150-56 ft. intervals. Two 500-gal. mud-acid treatments had no effect, and operators then pressure-injected 1,000 gal. of kerosine, followed by 3,000 gal. of fracture fluid mixed with 3,000 lb. of sand.

The well kicked off without swabbing and flowed 348 bbl. of oil in 24 hours. At last report the well had settled down to 9 bbl. of oil an hour.

The discovery is 5 miles north of Good-Pennsylvanian field, 6 miles east of Spraberry field, in Dawson County, and one county north of Spraberry Trend fields.

Saint Anne's Buys Neb-Tex

MIDLAND, Tex.—Saint Anne's Oil Production Co., Northwood, Iowa, has bought out Neb-Tex Oil Co. for a sum in excess of $750,000, W. J. Finch, president of Saint Anne's, said here last week.

The deal included 25 producing wells in Malicky field, Pecos County, West Texas, and 546 acres of undeveloped leases.

Saint Anne's owns substantial other production in West Texas and Southeast New Mexico. The company plans to open a production office in Midland in the near future. Bernard Klein, Northwood, is board chairman of the company.

North Texas Flood Asked

AUSTIN.—G. E. Kadane & Sons and Fain & McGaha have applied to the Texas Railroad Commission for permission to undertake a water-flood program which they estimate will recover 500,000 bbl. of additional oil from the Strawn sand in Daume field, Archer County, North Texas.

Cumulative production from the acreage to date is around 2,500,000 bbl., Roland Gouldy, spokesman for the applicants, told Commission Examiner Mac Coker. The 43 wells in the field, he said, are drilled on a 20-acre pattern and are producing an average of about 4 bbl. of oil daily each from the Strawn at about 4,000 ft.

The field has operated under a solu-

tion gas drive, and all gas produced is processed and the residue returned to the formation, Gouldy said. Unless the water flood is approved, the field will soon have to be abandoned, he said.

Sapphire Buys Texas Wells

SAN ANGELO, Tex. — Sapphire American Petroleums, Inc., a wholly owned subsidiary of Sapphire Petroleums, Ltd., Toronto, Ont., has purchased four producing oil wells in Olson field, Crockett County, from H & F Oil Co.

The wells are on a 80-acre tract of the Shannon Estate on the Archer CSL. All were drilled between May 1950 and May 1951 and produce 40 bbl. daily. Maxwell Goldhar, Sapphire president, said engineering reports indicate this production can be increased appreciably.

Allowable Boost Due?

AUSTIN, Tex. — An increase of 200,000 bbl. daily in March production in Texas is deemed due by Ernest O. Thompson, chairman of the Texas Railroad Commission.

Thompson said, "In my opinion, after careful check of the stocks on hand, Texas is now entitled to this increase." He said it is his "sincere hope" that evidence offered to the commission at a hearing February 19 will justify that increase.

Texas' allowable for the last week of January averaged 2,887,390 bbl. per day, but was reduced to about 2,860,000 bbl. daily, counting new wells, for February.

Index Is Ready

The Oil and Gas Journal's 1953 index has been compiled and printed and is now available to all subscribers.

The index lists all technical articles and significant news stories printed in the Journal during 1953. The material is cross-indexed by author, geographical area, and by subject to increase its value in reference work.

To get your copy, drop a letter or post card to the Editor, The Oil and Gas Journal, Box 1260, Tulsa.

TECHNOLOGY

New Tool Promising

Instrument obtains nine kinds of bottom-hole data, such as mud pressure and temperature, weight on bit, stresses

D. H. Stormont

LOS ANGELES.—A subsurface recording instrument developed to study the performance of an experimental percussion-type drill promises to be of great assistance in studying bottom-hole drilling conditions.

The recorder is being used by Borg-Warner Corp.'s Petro-Mechanics Research Division in several California fields to plot the stresses, vibration, pressures, and other physical conditions which exist while actual drilling, either rotary or percussion, is under way.

Basic element of the instrument is a small recording oscillograph equipped with its own power supply. It is installed in the drill string between the bit and drill collars in such a manner as to be pressure tight but permit full flow of drilling fluid. It was designed for use at depths of 10,000 to 15,000 ft. and for withstanding jarring and very high impact loads. Its shock-absorbing mountings are so nearly perfect that the delicate instruments used are not damaged by these tremendous forces.

Information picked up by strain gages, transducers, velocity pick-ups, or other measuring devices is charted on the nine-channel oscillograph. Plottings are made on a 3½-in. strip of specially treated paper about 40 ft. in length. In initial work the speed of recording was about 6 in. per second of "on" time.

Other work uses long-time recording by making a series of short starts and stops.

Charts are readily removed from the instrument when the drill string is pulled for a bit change or other reasons.

What it can do . . . With nine recording channels available, any eight variables can be covered at one time and still maintain correlation with the remaining one.

Some of the possible measurements which can be recorded are: weight on bit, mud pressures and temperatures, vibration and chatter frequencies of the bit, stresses near the bit, and acceleration, velocity, displacement, and revolutions per minute of the bit.

The 9½-in. o.d. instrument sub is constructed to give an instrument cavity approximately 5 in. square and 30 in. long. Sections are provided in the walls to permit full flow of fluid through the sub. Operation of the recorder is not started until the bit is on bottom. The starting mechanism is actuated by a surge of mud pressure rupturing a disk or some other means.

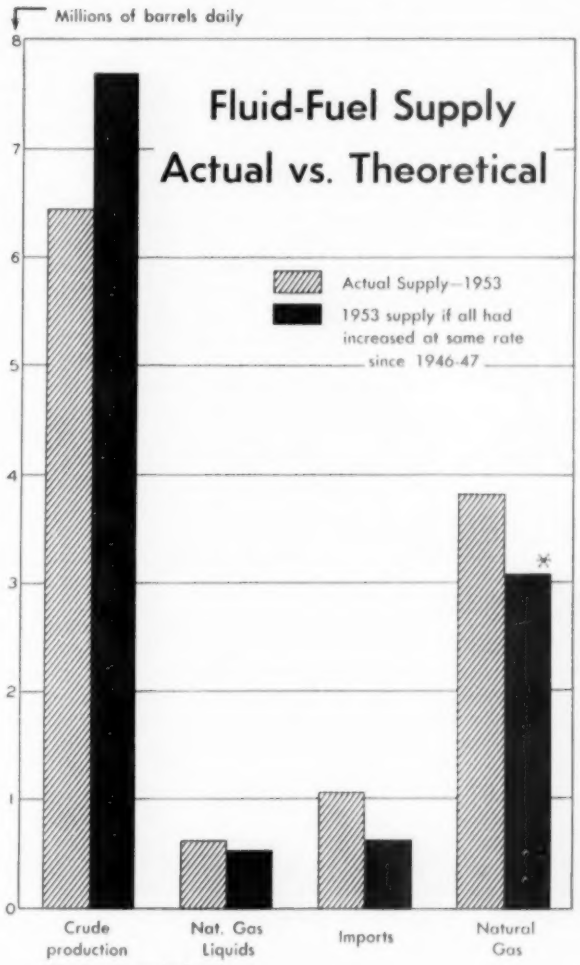
Equipment housed in the sub other than the recording oscillograph, which was a Consolidated type 5-118, include: integrating galvanometers; an oscillator to provide timing marks at 1, 1/10, and 1/100 second; a nine-channel bridge balance; a program sequence timer; a power supply for the bridge of 3-6 and 9 volts d.c.; and a 24-v. d.c. power supply for the recorder and sequence timing motor.

In initial test operations only relatively short periods of bit performance could be analyzed because 5-second plots were made at 30-second intervals. By greatly shortening the plotting period and lengthening the interval between records it is believed charts can be made to extend over the entire performance life of a typical rock bit.

TEST ENGINEERS of Borg-Warner crew place the recording oscillograph in the instrument sub, which is run just above the bit in the drill string.

Domestic Crude Losing to Imports And Other Fuels

Output now would be 7,700,000 bbl. daily if it had risen at the same rate as gas, gas liquids, and imports



*Crude-oil equivalent.

John C. Casper

THEORETICAL demand for domestic crude could have reached 7,700,000 bbl. daily in 1953 if all competing fluid fuels had increased at the same percentage rate since the end of World War II.

It has been generally known that production of natural gas and natural-gas liquids have increased at a faster pace than production of crude. Also, since the war, imports have supplied an increasingly larger percentage of this country's total demand.

One method of comparing the rates of increase is a calculation of the theoretical division of the supply of these fuels for the year 1953, assuming equal percentage increases for each since the end of the war.

It is not intended to imply that all of these fuels should increase at the same rate nor that the division of the fluid-fuel market in the period just after the end of the war was ideal. The comparison of actual current production with theoretical production based on equal percentage increases is presented as a means of measuring the effects of the different rates of gain in the competitive fluid-fuels market.

Basis for figures . . . From the comparison, average production or supply in the years 1946-47 is selected as a base. Average annual imports and productions for these years are expressed as crude equivalents, on an energy basis with 6,000 cu. ft. of natural gas equal to a barrel of crude and 1 bbl. of natural-gas liquids equal to 0.767 bbl. of crude. Since residual fuel makes up most of product imports, total imports are credited on a barrel-for-barrel basis with crude.

The four sources of supply in the 1946-47 period were equivalent to an average of 2,757,875,000 bbl. of crude per year. The second part of the table shows the breakdown of supply in 1953 which was equal to the energy of 4,331,207,000 bbl. of crude. On a crude-equivalent basis, total energy from the four sources in 1953 represented an increase of about 57.05 per cent over the average for 1946-47.

The third part of the table shows theoretical annual totals for 1953 with

AVERAGE SUPPLY 1946-47

	Supply	Crude equivalent* (1,000 bbl.)
Crude prod. (1,000 bbl.)	1,795,463	1,795,463
Natural-gas liquids (1,000 bbl.)	125,356	96,148
Imports (1,000 bbl.)	148,533	148,533
Natural gas (M.M.c.f.)	4,306,389	717,731
Total		2,757,875

SUPPLY IN 1953

Crude prod. (1,000 bbl.)	2,359,725	2,359,725
Natural-gas liquids (1,000 bbl.)	242,360	185,890
Imports (1,000 bbl.)	381,425	381,425
Natural gas (M.M.c.f.)	8,425,000	1,404,167
Total		4,331,207
Per cent increase over 1946-47		57.05

1953 SUPPLY ON EQUAL-INCREASE BASIS

Crude prod. (1,000 bbl.)	2,819,752	2,819,752
Natural-gas liquids (1,000 bbl.)	196,870	150,999
Imports (1,000 bbl.)	233,269	233,269
Natural gas (M.M.c.f.)	6,763,122	1,127,187
Total		4,331,207

1953 COMPARISONS

	Thou. bbl. daily — Actual	Theoretical
Crude production	6,465	7,725
Natural-gas liquids	664	539
Imports	1,045	639
Natural gas (M.M.c.f. per year)	8,425,000	6,763,122

*One barrel of natural gas liquids equals 0.767 bbl. of crude and 6 M.c.f. of natural gas equals 1 bbl. of crude.

each division of supply increasing 57.05 per cent over its average for 1946-47.

A comparison of this theoretical supply for 1953 with actual data for that year shows that crude production would have been much larger in 1953 if the four had increased at the same rate. The increase for crude would have been balanced by losses for the other three supply sources.

Comparisons of actual supply data with the theoretical totals based on equal percentage increases, are shown in the fourth part of the table.

Marketed production of natural gas is shown on the chart, expressed as its crude equivalent for comparison with the other liquids. Note that on an energy basis, actual production of natural gas in 1953 corresponded to almost 60 per cent of crude production. In 1946, total energy of marketed natural gas amounted to about 39 per cent of the energy in domestic crude produced in that year.

What's ahead . . . For the 7-year period 1946-53, the average annual increase in domestic crude production was about 4.5 per cent compared with an average yearly gain of 11.1 per cent for natural gas. If these rates of gain were continued, natural gas would catch up with crude in almost 10 more years.

However, use of natural gas is not expected to climb as rapidly in the next 10 years as in the period since the end of the war, and the growth in production of natural-gas liquids will be related to gas production.

If percentage gains in imports are held to near the level of crude production gains, the crude producer will get a larger portion of the increases in the fluid-fuel market over the next few years.

GULF COAST

Sun Wildcat Successful

McALLEN, Tex.—Sun Oil Co. last week reported a new gas-condensate discovery 16 miles east of Rio Grande City, in the southwestern corner of Hidalgo County, near the Starr County line.

The pool was opened by the company's 1 Murch, in Porcion 41, and has been designated officially as Bloomberg field.

Production is from Vicksburg sand, topped at 5,986 ft. from surface elevation of 306 ft. and perforated at 5,986½-99½ ft. Open-flow potential of the well was calculated at 1,930,000 cu. ft. of gas daily with condensate yield of approximately 30 bbl. on the basis of a gas-fluid ratio of 64,901 cu. ft. per barrel. Shut-in pressure gaged 2,897 psi. Gravity of the fluid was 53°.

Louisiana Strike Reported

ABBEVILLE, La. — An important new oil discovery for South Louisiana appears to have been made by Houston Oil Co. of Texas at its 1 Godchaux, a wildcat test 15 miles south of here in Vermilion Parish.

Testing a sand interval at 12,334-40 ft., the well flowed 386 bbl. of 37°-gravity oil on a 24-hour gage through 10/64-in. choke with pressure of 2,050 psi. Bottom-hole pressure was 5,730 psi. Gas-oil ratio measured 900:1.

Operators previously had tested a deeper zone at 12,900-10 ft., recording a flow of 5,500,000 cu. ft. of gas and 275 bbl. of condensate per day.

Location is 6 miles from nearest other production in South Erath field.

The discovery is the second in the parish within a week. Amerada Petroleum Corp. opened gas-condensate production in a wildcat, its 1 Clothil Landry, 4 miles northwest of Kaplan, in the northern part of the parish. Amerada's well, testing 75 bbl. of condensate with 285,000 cu. ft. of gas daily from sand at 11,758-75 ft., is 25 miles northwest of the Houston Oil Co. oil producer.

Higher Permit Fees Planned

NEW ORLEANS. — Oil companies planning to drill in navigable waters along the Gulf Coast may soon have to pay up to $175 for a permit from the U. S. Army Corps of Engineers.

Col. C. T. Tench, district engineer at New Orleans, last week said the Secretary of the Army is considering a schedule of fees to recover the cost of issuing permits. The procedure change would be in line with a law passed by Congress in 1952 providing that agencies recover "to the extent possible" the cost of federal services rendered.

For the oil industry the new schedule would mean that permits for offshore structures costing more than $25,000 would cost $175, those under $25,000 would cost $100.

Similar fees would be charged for shoreline structures often associated with offshore drilling programs, such as berthing areas, revetments, piers, and wharves.

Gas Field Opened

McALLEN, Tex. — A wildcat gas well, located 2 miles northeast of the most northerly producer in the multi-pay Monte Christo field, 16 miles north of Mission, in Hidalgo County, has been completed by Superior Oil Co.

The well is 1-B Hamman, Block 264, Jackson Subdivision of Melado Tract, in San Salvador del Tule Grant.

The discovery well, designated as North Monte Christo field, is shut in under pressure of 3,763 psi. following potential tests in which it flowed at a calculated open-flow rate of 1,470,000 cu. ft. per day. It had a gas-liquid ratio of 141,000 cu. ft. per barrel of 52°-gravity condensate.

Production is from a sand interval at 8,326-36 ft. in hole drilled to 10,440 ft.

Monte Christo, also discovered by Superior, was opened early in 1953. Gas-condensate production has been proved in a series of reservoirs at depths ranging from 6,300 ft. to below 8,500 ft.

Sun Seeks Offshore Permit

HOUSTON.—An extenisve drilling program off Mustang and Padre Islands, Nueces County, Texas, is planned by Sun Oil Co.

The company last week applied to the U. S. Army Corps of Engineers for a blanket permit to drill on 35 tracts extending outward as far as 4½ miles.

B. C. Brooks, Sun general superintendent in Dallas, said barges will be used in shallow waters close to shore. In deeper water, Sun plans to employ a 52 by 106-ft. platform and a tender ship. Preliminary plans, Brooks said, call for directional drilling of several wells from the platform, if production is found, with the rig being skidded after each hole is completed.

Up to now only one company—Stanolind Oil & Gas Co.—has announced plans to drill beyond the 10½-mile limit, on lands controlled by the federal Government *(The Oil and Gas Journal, February 1, page 42)*.

Gulf Seismic Permit Sought

GALVESTON.—Hunt Oil Co., Dallas, which paid $648,145 in bonuses for 67 tracts totalling 102,956 acres in December's Texas lease sale, has asked the U. S. Corps of Engineers for seismic permits on the offshore tracts.

Hunt seeks permission to shoot an area from the Colorado River discharge channel, 10 miles northeast along the coast and extending a mile into the Gulf.

Growth Only Natural

Rise of nation's large, integrated companies credited to oil industry's intense competition by Harvard study

CAMBRIDGE, Mass.—Intense competition—not the lack of it—has encouraged the growth of this country's large integrated oil companies.

That is the conclusion of an exhaustive study just published by the Harvard Business School's division of research and authored by John G. McLean and Robert William Haigh.

"If profits were easily won and competition generally soft in the oil industry, there would be no particular reason for a company to alter continually its integration arrangements," the authors say.

The study reveals oil companies have been under intensive pressure throughout history to perform several of the steps in moving the oil from the ground to the gas tank—rather than just one.

The survey points out that one basic reason for this is the fact that profits may be good in one segment of the industry at the same time they are nonexistent in another. Another factor becoming increasingly important is the size of investment required for a refinery or a pipe line.

No company can afford, for example, to invest from $20,000,000 to $100,000,000 in a refinery unless it is assured of both a dependable source of crude oil and a market for the product. This has led to integration "backward" to production and "forward" to marketing.

What integration has done . . . The study shows at least 48.6 per cent of the nation's refining companies have some kind of integrated structure. They have 93.2 per cent of the refining capacity, 85.4 per cent of the crude-oil gathering lines, 82.1 per cent of the crude-oil trunk lines and 92.2 per cent of the products lines.

At the "ends" of the oil process, however, integration falls off. These same companies hold only 7.7 per cent of the drilling rigs, 35.4 per cent of the producing wells and 51.6 per cent of the service stations.

The study is based on a survey of 106 companies representing 59.2 per cent of the operating refining companies and 94.7 per cent of the refining capacity. In addition detailed analysis was made of the files of Gulf Oil Corp., The Texas Co., Sinclair Oil Corp., Ohio Oil Co., Atlantic Refining Co., Standard Oil Co. (Ind.), and Standard Oil Co. (Ohio).

Process is natural . . . The authors compare the growth of oil companies to the forces "found at work throughout the entire world of living organisms." They point out that companies, like organisms, must continually alter their structures and seek new adaptations to the realities of "surroundings" if they are to "remain strong and vigorous and withstand the relentless pressure of business competition."

The authors point out that small companies have seen their share of the nation's refining capacity drop from 28 to 15 per cent in the past 30 years, but add "there are many profitable fields still open to small firms" provided they use wisdom in the selection of their fields.

The declining role of small refiners has been a natural occurrence, the authors say, and could have been avoided only by "strong, artificial restraints on the economic, technological and competitive forces" of the industry.

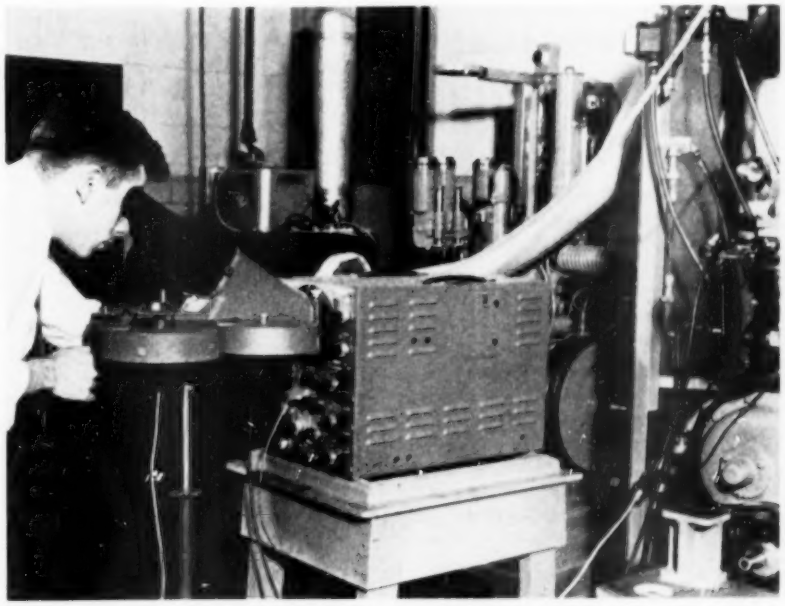
Recorder Licensed

Instruments, Inc., to make new Gulf interface detector

HOUSTON.—Gulf Research & Development Co. revealed here last week that it has completed a licensing arrangement with Instruments, Inc., Tulsa, for the manufacture and sale of its new interface and b.s. and w. recorder.

Details of the recorder were first revealed last fall when a paper by two Gulf Research engineers, Howard J. EnDean and Robert M. Howard, was delivered at an A.S.M.E. conference (*The Oil and Gas Journal, October 5, page 138*). A second paper recently delivered by J. D. Jones, Tulsa, before the Gulf Research and Production conference in Pittsburgh will appear in an early issue of the Journal.

In revealing the licensing arrangement, Gulf Research officials here said all orders or requests for technical information on applications of the device should be forwarded to their com-



New Camera Televises Motor Fuel Tests

A high-speed camera is now being used by Standard Oil Development Co. to make a kinescope of gasoline and motor oil tests inside an engine. A cathode ray Oscillograph televises pressure pulses inside the engine and furnishes a kinescope film record for later study. A researcher at the company's Linden, N. J., laboratories is shown operating the camera recording the antiknock performance of an experimental gasoline.

pany at Harmarville, Pa. Gulf will analyze the application and determine the type of instrumentation required. The instructions for installation will be transmitted to Instruments, Inc.

How it works . . . The instrument indicates instantly any change in the characteristics of the stream flowing through its detector, made in spool form and inserted directly into the pipe line. The detector uses cylindrical electrodes as the plates of a condenser and the pipe-line stream as the dielectric material.

In the case of crude service, operation is based on the fact that the dielectric constant of the stream is a function of the b.s. and w. content. Any change in the content is reflected as a change in the detector circuit capacitance, causing external circuits to perform control or recording operations.

Use of the instrument in products lines is feasible because the various products exhibit different dielectric constants. This allows the instrument to detect and record the passage of the interface between products.

Officials of Instruments, Inc., say the average installation will cost about $1,000, depending upon mechanical problems involved and whether the instrument is to be used for control purposes or merely for recording. Detectors for the instrument may be installed on any size line.

Big Tanker Afloat

Capacity of 393,000 bbl. makes it world's largest

QUINCY, Mass.—The world's largest tanker as judged on the basis of carrying capacity was launched February 9 at Bethlehem Steel Co.'s shipyard here.

The vessel is the World Glory built for World Tankers Co., Inc., one of the companies of the Greek shipowner, Stavros S. Niarchos.

It has a deadweight of 45,130 tons and a carrying capacity of 16,500,000 gal., or about 393,000 bbl. The World Glory will fly the Liberian flag and will operate under charter to Gulf Oil Corp. for service in and out of New York.

Mrs. William K. Whiteford, wife of the Gulf president, broke the bottle of champagne against the tanker's bow at the launching.

The new tanker's carrying capacity is about 17,800 bbl. greater than that of the Tina Onassis, recently completed in Germany. The Tina Onassis' 45,720-ton size is slightly exceeded by another giant tanker of 45,800 tons under construction in Japan.

The World Glory has a speed of 16 knots and cost around $10,000,000. It is the largest commercial vessel ever built in the United States apart from the superliner United States.

Oil Title Ruling

Court says Arkansas lacks law on sale of oil rights

LITTLE ROCK, Ark.—The Arkansas Supreme Court has ruled that only surface rights of lands forfeited to the state for nonpayment of taxes may be acquired by a purchaser at a tax resale.

The court ruled against Manie Schuman, Little Rock, and eight others who attempted to acquire oil and gas rights on Ouachita County lands through a county sale after taxes on the mineral rights became delinquent.

The court held that Arkansas has no law providing for the purchase of mineral rights through tax sales simply because the legislature has never passed one. Schuman and the other would-be purchasers contended the matter was covered by the statute providing for sale of lands on which taxes are delinquent.

The court held that since Arkansas had no oil and gas operations in 1836 when the law providing for these tax sales was written, "it is not reasonable to suppose the legislature intended for the word 'land' to include interests in oil and gas."

System gets blame . . . The question went to the Supreme Court after Schuman and his associates "bought" the oil and gas rights at a tax sale and tried to have them confirmed by the chancery court. The lower court refused to confirm the rights and the case was appealed.

Attorneys involved in the case said some of the leases involved are productive. They blamed inconsistencies in Arkansas' system of assessing mineral rights for taxation for the lawsuit. Holders of the mineral rights involved did not know taxes on their leases were delinquent, their attorneys said.

Under Arkansas law, mineral interests are subject to a separate tax assessment when they have been severed from the surface rights, but attorneys said assessment procedures are not consistent and the assessments are not always made.

Selling Job Gains

O.I.I.C. makes progress, but still has more to do

NEW YORK.—The oil industry's effort to sell the American public on the idea that oil is a highly competitive field is paying off—but it still has a long way to go.

The latest nation-wide survey conducted by Opinion Research Corp. for the Oil Industry Information Committee of the American Petroleum Institute, reveals that the O.I.I.C. has made progress since 1950, but it has its negative side also.

On the credit side:

. . . A gain of 7 per cent in the number of people who regard the oil industry as competitive. The 2,542 personal interviews involved show that 50 per cent believe the industry is competitive rather than monopolistic. That figure was 43 per cent in 1950.

. . . People do not believe we are "running out of oil," and 71 per cent agree that oil companies do their utmost to conserve the nation's natural resources.

. . . A majority of the people (82 per cent) believe the oil industry job of product improvement is equal to or better than other industries.

. . . One-third of the public has recently read articles about the oil industry, while one in eight reports having seen movies on the subject.

On the negative side:

. . . A gain of 12 per cent over 1950 in the number of people who think the price of gasoline is too high. The research firm points out, however, that this may be partly a protest against higher prices generally.

. . . Twenty-seven per cent of the people think the profit level in the oil industry is too high, although 52 per cent are satisfied that oil companies make either a fair or too little profit.

. . . More people than in previous surveys have the opinion that a few large companies control the industry in spite of the growing favorable public impression of the industry. The research company says people apparently see no inconsistency in this view "probably because they recognize that both large and small companies compete actively with one another."

. . . Forty per cent of the people have heard that oil companies buy up and "suppress" gasoline-saving devices and nearly two-thirds of those interviewed seem inclined to believe such rumors are true. Even more startling is the 21 per cent who said they had not heard such rumors but would be inclined to believe them if they had heard them.

Plant Study Stepped Up

TULSA. — Hydrocarbon Research, Inc., will assist Stanolind Oil & Gas Co. in its evaluation of the Carthage Hydrocol plant at Brownsville, Tex., which Stanolind may acquire.

A. L. Solliday, Stanolind executive vice president, said Hydrocarbon Research has been engaged to help with an estimate of plant modifications and additional facilities that would be needed to put the gas-synthesis plant into operation.

Stanolind earlier had announced letting of a contract to Lummus Co. as consulting contractor on the project.

Owners of the huge Brownsville plant wrote off their investment and turned the plant back to the Reconstruction Finance Corp., holder of a first mortgage on the facilities. Stanolind obtained from RFC an option to acquire the plant in an agreement which expires March 29.

Stanolind has been interested in Carthage Hydrocol because the company operates an adjacent $15,000,000 chemical plant which was built to process a byproduct chemical stream from the gas-synthesis plant. The Stanolind plant is now shut down.

CANADA

Dow to Expand Plant

SARNIA. — Dow Chemical Co. of Canada plans to begin construction early in March on a $3,000,000 expansion of its synthetic ammonia plant here.

The project will increase capacity to more than 100 tons per day. Some hydrogen for synthesis will be obtained from the new 3,000-bbl. Houdriformer now under construction at the nearby Sun Oil Co., Ltd., refinery.

Saskatchewan Sets Sale

REGINA, Sask.—Saskatchewan will hold its first 1954 lease sale February 26 when bids on 41,114 acres will be opened here.

The 41,114 acres involved in the sale will be divided into two blocks in the Weyburn-Fillmore area. Under government regulations drilling must be started on each of the two blocks within 15 months from March 1, effective date of the leases.

Farmout Deal Made

EDMONTON, Alta.—Kroy Oils, Ltd., has secured a farmout from Stanolind Oil & Gas Co. covering 18,880 reservation acres located 18 miles due north of a tract for which Imperial Oil, Ltd., paid more than $11,000,000 at the recent Alberta crown lease sale.

Stanolind will surrender a 50 per cent interest in the reservation in exchange for a well drilled to the Madison. Kroy plans to retain only 25 per cent of its half interest in the farmout. Anglo Canadian Oil Co., Ltd., will have 40 per cent, British American Oil Co., Ltd., 25 per cent, and Bralsaman Petroleums, Ltd., 10 per cent. Anglo Canadian will be operator for the project.

ALASKA

Materials Shipped

Pipe-line equipment begins to arrive at Alaskan ports

ANCHORAGE. — Heavy equipment, machinery, building materials, and supplies for the Haines-Fairbanks military pipe line are already beginning to arrive in Alaskan ports as construction engineers point toward spring weather and a full work schedule.

Maj. John E. England, Anchorage resident U. S. engineer, said last week that the organization is "shaping up."

"By June we'll be working with a full head of steam."

England disclosed that British firms will supply 8-in. pipe for the 280-mile portion of the line which crosses Canadian territory. U. S. firms will supply the pipe for the line within Alaska.

The first load of British pipe, 5,500 tons from Stewart & Lloyd of London aboard the SS. Nordness, is due to arrive at Lutak Inlet near Haines late this month. The pipe is expected to cover about 80 miles of the 280-mile Canadian link of the line.

American ships with cargoes of 75,000 tons of Jones & Laughlin Steel Co. pipe from Aliquippa, Pa., are scheduled to arrive in Haines, Valdez and Seward at intervals between February 28 and May. Another 4,000 tons of National Tube Co. pipe is being routed down the Ohio and Mississippi rivers by barge to New Orleans and shipped through the Panama Canal, up the West Coast to Alaska.

More than 150 tons of construction equipment and camp building materials have already been unloaded at Lutak Inlet.

Heavy equipment expected to arrive shortly includes 28 diesel-powered pipe layers, bulldozers and mammouth diesel shovels to be shipped by Northern Commercial Co. from Peoria, Ill.

Joint venture firms awarded the $29,000,000 contract for the 621-mile products line are Williams Bros. Constructinon Co., Tulsa; McLaughlin, Inc., Great Falls, Mont., and Marwell Construction Co., Vancouver, B. C.

Industry Briefs

DALLAS.—Lone Star Gas Co. has completed its $350,000 purchase of production and transmission properties from Central Texas Gas Co. The properties included Central's interest in about 40 gas wells in Brown and Coleman counties in Central Texas, certain transmission lines including one from Brownwood to Blanket, and distribution plants at Blanket and May in Brown County.

AUSTIN.—Texas' gross production tax on crude oil brought in $9,778,302 to the state treasury during January, Comptroller Robert S. Calvert reported last week. The state's take from other petroleum and related taxes during the month was: gross production tax on natural and casing-head gas; $1,802,799; gas-gathering tax, $246,209; gross production tax on carbon black, $144,022.

SANTA FE, N. M.—The oil conservation agencies of Texas and New Mexico will consider regulations for the Bronco (Devonian) oil pool which straddles the Texas-New Mexico state line at a joint meeting here February 26. The pool is northeast of Lovington, N. M.

TALLAHASSEE Fla. — Florida's oil production for 1953 dropped almost 50,000 bbl. under 1952 production, figures released here by Dr. Herman Gunter, director of the Florida Geological Survey, reveal. Florida's sole producer is Humble Oil & Refining Co. which produced 541,284 bbl. from Sunniland pool, the state's lone field. Last year's production was 591,855 bbl.

AUSTIN.—Oil operators are being asked by the Board for Lease of University Lands to submit lists of tracts in which they are interested by March 13 for a lease sale tentatively scheduled for May. The board asks that operators designate first, second, and third choices on acreage to be offered.

Shelf Rules Issued

Interior Department submits proposed regulations covering development on outer shelf, asks comment from industry

WASHINGTON.—Proposed regulations for development of the outer Continental Shelf were published last week by the Interior Department.

As with public lands, leasing activities will be conducted by the Bureau of Land Management. Supervision of operations will be under the Geological Survey.

The regulations do not cover such subjects as well spacing, field rules, and allowables. These will be incorporated later in additional regulations and will closely parallel state conservation rules.

Provisions in the new regulations include:

1. Leases will be awarded by competitive bidding, with lease areas not exceeding 5,760 acres.

2. The Government reserves rights to all helium and the right to build any extraction facilities on the lease.

3. Joint operations will be permitted, including use of a single platform to develop adjacent leases.

4. Underground storage will be permitted, whether or not oil is produced on the lease.

5. A lease may be maintained in force by wells drilled directionally from adjoining lands.

6. Oil and gas leases will be for a term of 5 years and so long thereafter as there is commercial production or drilling or reworking operations.

7. Royalty will be a minimum of 12½ per cent, and may be higher if specified in the lease.

8. Provision is made for recognition of leases granted by the states and which qualify for federal leases under the Outer Continental Shelf Act.

9. Employes on the lease must not be discriminated against because of race, color, creed, or national origin, and employes must be assured "complete freedom of purchase."

10. In time of war the United States shall have first call on all oil at the market price. Upon the recommendation of the Secretary of Defense, during war or emergency, the Secretary of Interior can suspend any operations, with just compensation being paid the lessee.

11. The United States may withhold any areas designated by the Secretary of Defense as needed for national defense and may conduct its own exploratory operations.

The regulations covering operations under supervision of the Geological Department generally follow those for public-lands development.

It is pointed out, however, that in addition to the survey's requirements lessees must comply with requirements of the Army Department and Coast Guard with respect to prevention of obstruction to navigation, lights and warning devices, and other matters.

Interested parties are given 30 days in which to submit written comments, suggestions or objections on the proposed regulations to the solicitor of the department.

Naval Trade Brews

Standard's Elk Hills swap offer is being reconsidered

WASHINGTON.—A trade of Elk Hills holdings between Standard Oil Co. of California and the Navy which bogged down during the Truman administration is being studied again.

The company owns roughly one-third of the oil and operates the Naval Petroleum Reserve No. 1 under a contract with the Navy. Standard has long been eager to pull out and in 1952 proposed a trade to allow its ultimate withdrawal.

Standard offered to transfer to the Navy all its interest in the deeper Stevens Zone, better suited to the Government's objective of maintaining a reserve. In return, the company would receive an equivalent volume of oil in the Shallow Zone from the Navy. Because of complex reservoir conditions, partial depletion and water encroachment, the Shallow Zone is less suited for a reserve.

In addition, Standard offered to transfer 15,000,000 bbl. of its Shallow Zone reserves to the Navy and spend $1,000,000 a year for development of the zone.

Under the plan the Navy would continue control of production of the Shallow Zone but oil produced in non-emergency periods would go to Standard and be charged against its share. During an emergency the Navy would take the production.

It has been reported that the Navy would like to own the reserve outright and that Standard is willing to sell its interest, but the amount involved in a cash purchase would be so great that it might prove impossible to secure congressional approval.

A study of the production potentials of both zones is being made for the Navy by an outside consulting firm, and the matter has not yet reached a point where a negotiated deal could be submitted to the Senate and House Armed Services Committees, which would have to approve it even though no legislation was considered necessary. There has been no indication what Rep. Carl Vinson of Georgia, "watchdog" over Navy's oil operations in the House committee, would think of the proposal.

Benzene, Acid Goals Met

WASHINGTON.—The Office of Defense Mobilization announced last week that the expansion programs for benzene and sulfuric acid, two of 49 industrial mobilization programs that have been under study for 2 months, have been closed.

Two other programs, however, synthetic methanol and toluene, have not reached their goals and will be continued, ODM said, and further applications for accelerated amortization of that project are invited.

The list did not include the refinery expansion and other programs directly related to the oil industry, which have not yet been completed. It dealt only with a number of programs the status of which was in doubt in December when the study was undertaken.

ODM Checking Tax Permits

WASHINGTON.—Holders of certificates for accelerated amortization of new facilities are being asked by the Office of Defense Mobilization to report whether they are going ahead with their expansion programs.

The information, so far as the oil and gas industry is concerned, will show whether there has been any substantial abandonment of plans for new basic refinery projects. This will assist the ODM in determining whether to call for a new study in March or April of the industry's expansion goal, now set at 8,750,000 bbl. daily by next January 1.

Companies which have not exercised the tax privilege within the time limits set forth in certificates will lose their benefits.

Ship Fraud Charged

October indictment of nine individuals, six corporations for conspiracy in U.S. surplus tanker purchases revealed

WASHINGTON.—The indictment of a former Massachusetts congressman, eight other individuals, and six shipping corporations on charges of conspiracy in connection with the purchase of surplus tankers and other vessels was revealed last week.

The indictment, which followed lengthy congressional investigation into the handling of surplus tankers and other ships, charges a conspiracy to violate the false statement statute, with reference to statements filed in the purchase of the surplus vessels.

Defendants in the case are Aristoteles S. Onassis, a citizen of Argentina of Greek extraction who is a shipowner and shipbuilder; Joseph E. Casey, former congressman, and Joseph H. Rosenbaum and Robert W. Dudley, all of Washington; Robert L. Berenson, now residing in Paris, France; Nicholas Cokkinis, Charles Augenthaler, and Harold C. Becker, all of New York; and George Cokkinis, reported to be abroad.

The companies named are United States Petroleum Carriers, Inc.; Victory Carriers, Inc.; Central American Steamship Agency, Inc.; Sociedad Industrial Maritima Financiera Ariona Panama; Sociedad Maritima Miraflores; and Transatlantic Financiera Industrial.

The eight-count indictment was returned by a District of Columbia grand jury last October 13, but was sealed until the return of Onassis, who arrived in this country early this month.

The indictment charges the defendants conspired to:

. . . **Submit false applications** with the Maritime Commission and its successor, the Maritime Administration, for the purchase of vessels.

. . . **Submit false balance sheets** and financial statements.

. . . **Make false citizenship statements** concerning the United States Petroleum Carriers and Victory Carriers, a wholly owned subsidiary.

The law provides that surplus vessels could be sold only to United States citizen-controlled companies.

United States Petroleum Carriers, of which Berenson is board chairman and former president, and its subsidiaries and related companies acquired a total of 25 vessels, 14 of them tankers.

The parent company acquired seven T-2 tankers directly from the Maritime Commission in a cash purchase for $10,557,470.23.

Victory Carriers acquired nine cargo vessels from the commission directly, and Victory and other subsidiary and related companies acquired seven T-2 tankers and two cargo vessels which, with the exception of one tanker, had originally been acquired from the Government.

How it started . . . The tanker deals came to light during a congressional investigation of the Reconstruction Finance Corporation in 1951.

The Senate investigations subcommittee went into the matter in hearings in February and March 1952, which centered on indications former congressman Casey and his associates netted $3,280,000 on an original investment of $101,000 in surplus vessels.

The investigation was particularly designed to develop possible tax evasion or avoidance by which the group bought tankers from the Government and sold them through their network of corporations.

Subcommittee members estimated the group saved at least $1,300,000 in income taxes over a 5-year period from the corporate organizations and foreign registry of the vessels.

A byproduct of the investigation was the implication and eventual dismissal of Newbold Morris, New York attorney appointed by former President Truman to "clean up the mess" of corruption in the Government.

The investigation revealed Morris was a member of the firm that handled the transfer of the ships from one company to another of which he was president.

The grand jury investigation was ordered by former Atty. Gen. James P. McGranery late in 1952 but was not started until last summer because of the crowded grand jury docket.

Tanker Fleet Deficient

WASHINGTON.—The U. S. tanker fleet has an "immediate deficiency" of 43 large vessels, according to computations by the Senate commerce subcommittee on shipping.

Further study of the subject will be made and specific recommendations for increasing tanker tonnage will be made in a future report, it was promised by Sen. Charles E. Potter of Michigan, chairman of the subcommittee.

A preliminary report charged the tanker shortage to the Defense Department where, the subcommittee said, there is a tendency "to dominate and preempt the privately owned and operated merchant marine in the field of merchant shipping."

The group called for a clear definition of the "limits of jurisdiction in the carriage of cargoes by the military," and suggested immediate legislation requiring that the services of the privately-owned, civilian-manned fleet "when available at reasonable terms and conditions" be used for the transportation requirements of the military departments and government agencies, "free from paralleling competition by government-owned and operated ships."

Defense Line Offer

Company volunteers to lay line parallel to its own

WASHINGTON. — A proposal to build a 24-26-in. defense pipe line from Texas to the East Coast, with government assistance eventually to be repaid, has been laid before the Office of Defense Mobilization by American Pipe Line Co.

The company now has a certificate for accelerated amortization for a products line to have a capacity of 300,000 bbl. daily, with an estimated cost of $145,337,000. It has offered to lay a parallel line with no pumping equipment, to be maintained in standby for 5 years.

The defense "B" line is estimated to cost $120,000,000, and it is proposed that the Government put up $60,000,000 over a 5-year period at the rate of $15,000,000 for each of the first 2 years and $10,000,000 a year thereafter.

After the 5-year period the company would be free to use the line and would begin to repay the $60,000,000 advanced by the Government.

Out of the $60,000,000 to be advanced, the company would stand the tax and other charges on the line while held in standby status.

The proposal has been sent to the Petroleum Administration for Defense for study. While officials would not comment, there is some question whether that agency will adopt a policy of recommending special treatment for an individual company.

PAD also is making a study for ODM of the West Coast pipe line project from Texas to California and has asked the Defense Department for its views on issuance of a letter holding the line essential to the national defense which has been requested.

Ammonia Plant Sought

WASHINGTON.—Negotiations are under way between the Army Department and American Cyanamid Co. for lease of the ammonia-producing facilities of the Missouri Ordnance Works at Louisiana, Mo., used until last June by the Bureau of Mines for its coal-to-oil demonstration plants.

The company's bid, the best of several proposals received by the Corps of Engineers, provides for a minimum annual rental of $343,980 a year. The company offered to pay the Government $13.23 on each ton of ammonia produced which, under maximum operating conditions, could amount to more than $500,000 a year.

The proposed lease would be for a 6-year period with two 6-year renewal options and a right to purchase the plant outright at any time within the first 3 years at approximately $3,325,000.

MSTS Boosts Tonnage

WASHINGTON.—The Military Sea Transportation Service moved approximately 132,000,000 bbl. of petroleum products from the Gulf of Mexico and the Middle East to our armed forces and allies in western Europe and Korea during the fiscal year 1953.

In a report of its operations, the MSTS showed that it transported 16,987,033 long tons of oil in 1953 compared to 14,461,505 tons in 1952.

During the first 8 months of 1953 tankers to augment the government's fleet were obtained from a voluntary tanker pool formed by industry with MSTS paying fixed rates established by the Maritime Administration.

British Oil Exports Up

WASHINGTON.—United Kingdom exports of refined petroleum increased substantially last year, in contrast with most other export commodities, it was reported last week by the Organization for European Economic Cooperation.

The OEEC's annual economic report, released simultaneously in Paris and Washington, showed that Western Europe is making progress but still has a number of obstacles to overcome.

There was practically no comment about refinery and other oil operations in the report, indicating that the European refinery expansion program has passed its peak. In their own reports, the individual countries disclosed that no quantitative forecasts of economic developments after the end of 1953 have been submitted to the OEEC.

WATCHING WASHINGTON

Bertram F. Linz

Surplus Refining Plan

Administration officials have been presented with a plan for halting over-production of refined products without endangering the mobilization program for refinery expansion.

Submitted by D. W. Hovey, president of the Danaho Refining Co., the plan calls for a tax benefit for refiners who curtail operations below their rated operating capacity when Bureau of Mines forecasts of demand show such action necessary.

The plan would work something like this: When the forecast called for operations at, say, 80 per cent of capacity refiners who cut back to that level would pay only 80 per cent of the income tax on their profits for the period of curtailed production. But any who operated above that capacity would get no tax saving.

It is Hovey's belief that in this way the oil industry would be able to prevent the accumulation of excessive inventories, such as occurred last fall, while at the same time providing an incentive to build reserve refinery capacity against an emergency.

Administration officials have said the plan is "interesting," but since it would involve a change in the tax laws it is a matter requiring congressional action.

"Wocs" May Serve Again

Liquidation of the Petroleum Administration for Defense will not necessarily end the government's call upon the oil and gas industry for "Wocs"—the men who serve without federal compensation.

Most of the top industry men who have served in PAD over the past 3 years were in the "Woc" class. The few still remaining will go home in the next few weeks when the Oil and Gas Division takes over PAD's remaining functions with an all-government cast.

While there has been no indication of any plan to do so, Interior Secretary Douglas McKay will still be able to call on the industry for volunteers to aid in any problems which may arise on which specialized aid is needed.

McKay will continue to be Petroleum Administrator under the Defense Production Act until that law terminates or the post is wiped out by the President.

Here's How Releases Work

Approval by Attorney General Herbert Brownell, Jr., of American company participation in a program to return Iranian oil to the world market has aroused some interest in just how the Department of Justice operates.

Clearances, generally known as "railroad releases," are granted from time to time when a company or group wants to make sure its plans are not going to run afoul of the antitrust laws.

In general, clearance is a waiver of the department's right to institute criminal proceedings with respect to a particular plan or program which has been submitted for review.

This waiver is granted only if full disclosure is made of all information necessary for consideration of the merits of the plan in relation to the antitrust law. The submitted plan must be prospective and not in actual operation, and the information submitted must disclose that both the plan and operations under it are not likely to be inconsistent with the antitrust laws.

Under this procedure, the department always reserves the right to institute civil proceedings if it decides to test the legality of the plan, and insists upon the understanding that the waiver of criminal prosecution will become inoperative if it appears that actual operations have extended beyond the limits of the proposed plan, or if a full disclosure has not been made.

As applied to the Iranian program, Brownell's release rigidly defined the area in which the companies' proposed operations would be approved—the division of purchases of oil and products in Iran—but reportedly specified that it would not extend to such matters as concerted action to cut back production elsewhere or, presumably, to any division of markets.

In essence, the railroad releases merely absolve the applicants of any premeditated intention of violating the antitrust laws, but do not give flat immunity.

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Gas Reserves Set

Proved supply of 560-610 billion feet is estimated

BISMARCK, N. D.—North Dakota's proved natural-gas reserves were estimated at 560 to 600 billion cubic feet here last week by two consultants testifying at a Public Service Commission hearing on a proposed 470-mile, $10,800,000 pipe-line system.

C. H. Keplinger, of Keplinger & Wanenmacher, Tulsa, estimated reserves in Beaver Lodge Madison pool at 187 billion cubic feet; Tioga Madison, 110 billion; Beaver Lodge Devonian, 68.04 billion; and Beaver Lodge Silurian, 195.56 billion.

Herman H. Kaveler, Tulsa, estimated total reserves at 610 billion, saying he figured a thicker oil section than Keplinger. Kaveler set Madison reserves in Beaver Lodge and Tioga at 350 billion, the Devonian at 60 billion, and Silurian 200 billion.

At present only Madison gas is being produced. All gas except that in the Silurian is produced with oil at a ratio of about 1,000:1.

The pipe-line proposal is that of North Dakota Natural Gas Co., which plans a system to move gas from the Signal Oil & Gas Co. gasoline plant between Tioga and Beaver Lodge fields to Grand Forks and Fargo *(The Oil and Gas Journal, November 30, 1953, page 46, and February 1, page 110)*.

Price disclosed . . . The hearing revealed that North Dakota Natural will pay 16 cents per M.c.f. the first year, with price increasing 1 cent per M.c.f. each 5 years until it reaches 19 cents in 1969. The contract terminates in 1974.

The gas will be purchased from Amerada Petroleum Corp., which owns 85 per cent of present proved reserves. Although Signal will process the gas, Amerada through its contract with Signal retains title to the gas and will also share in proceeds from the sale of extracted liquids.

The North Dakota Natural system will include 78 miles of 12-in. from Tioga to Minot and 88 miles of 10-in. from Minot to Fessenden. Here the line would split, with a 126-mile 10-in. leg running to Tokio and Grank Forks and another leg running to Fargo, consisting of 70 miles of 8-in. to Jamestown and 92 miles of 6-in. to Valley City and Fargo.

Joe E. Ross, Ford, Bacon & Davis engineer, testified that 2 months would be required for obtaining right-of-way, 3 months for construction, and another month for testing.

The hearing was recessed until March 15 to permit study of the transcript before cross-examination of witnesses.

Colorado Fields Combined

DENVER.—The Glenn Ranch, West Fork, and North Adena areas of Morgan County have been combined in one field by the Colorado Nomenclature Committee. It will be known as Adena field.

Forty-acre spacing for oil wells and 160-acre spacing for gas wells in both the Dakota D and J sands has been established by the Colorado Oil and Gas Commission. The commission order provides that future wells shall be drilled in the southwest quarter of each drilling unit set up. All existing wells were declared exemptions to this pattern and designated the allowed well for the drilling unit on which they are located.

The rapid growth of the Adena area has turned the drilling spotlight on Morgan County, in the Denver-Julesburg basin. The field is a few miles north of Little Beaver-Badger Creek field, the most active spot in the basin in 1953.

Plans for construction of a gathering system for Little Beaver and Badger Creek fields were announced last week *(See Pipe Line)*.

El Paso Purchase Reported

DENVER.—El Paso Natural Gas Co. reportedly has completed a deal with Mendota Oil Co. and Greenbrier Oil Co. for their interest in the 91,333-acre Twin Buttes unit in western Garfield County, Colorado.

Last year El Paso purchased a half-interest in lands held by Frank Buttram, Oklahoma City, in the same area. The purchase price was not disclosed in either transaction.

The discovery well in the field was drilled in 1952 by Mendota-Greenbrier and flowed at the rate of 7,700 M.c.f. of gas per day. The operators then made a Morrison discovery, completed with an estimated potential of 2,000 M.c.f. per day.

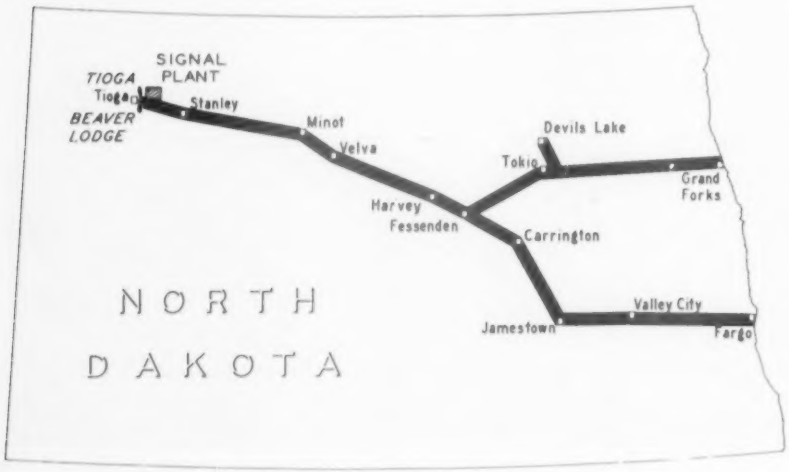
Utah Wildcat Finds Oil

DENVER.—A Three States Natural Gas Co. wildcat in the Bluff area of the Black Mesa basin in San Juan County, Utah, is flowing oil and gas from the Hermosa (Pennsylvanian).

The 1 Utah State showed as much as 6,000 M.c.f. of carbon dioxide gas with an oil spray of about 5 bbl. daily from perforations in the Leadville (Mississippian). Then the operator plugged back to the Hermosa.

After swabbing, the discovery flowed 40 bbl. of oil and 1,000 M.c.f. of sweet gas daily. After acidization, the well flowed 85 bbl. of oil in 6 hours and 1,500 M.c.f. of gas. Testing is being continued.

Shell Oil Co. recently recovered oil and gas-cut mud on drill-stem tests of the Hermosa at its Black Mesa basin wildcat in Apache County, Arizona. *(The Oil and Gas Journal, February 8, page 70)*. The well gaged 100 M.c.f. of inflammable gas per day. Located in an isolated northeastern part of the state, the well has spurred hopes of opening Arizona's first production.



The Uinta (Piceance Creek) basin of Colorado has been very active from a leasing and exploratory standpoint since that time in an effort to establish gas reserves for the region. Pacific Northwest Pipe Line is projected through this area.

The gas is marketed in the Grand Junction area by Public Service of Colorado.

Wildcat Gets Oil Show

WILLISTON, N. D.—Socony-Vacuum Oil Co., Inc., has recovered a slight showing of oil and gas in sample cut from the Otter (Mississippian) at its Teepee Buttes area wildcat in Hettinger County, southwestern North Dakota.

The Otter is in the Big Snowy Group of Mississippian age. The Heath (upper Mississippian) has shown for oil at several wells in North Dakota, but this is the first show reported in the Otter. The Heath also belongs to the Big Snowy Group. North Dakota production is from the Madison Group (Mississippian).

North Dakota Leases Sold

NEW TOWN, N. D.—Oil operators paid $560,578 for oil and gas leases on 17,097 acres in the Fort Berthold Indian Reservation, most of it in Mercer County. Only 97 tracts of the 229 tracts offered were sold.

Cities Service Oil Co. paid the high bid, $209.50 per acre for two 320-acre tracts. Operators buying acreage included Carter Oil Co. and Sinclair Oil & Gas Co., jointly, and Pure Oil Co., Socony-Vacuum Oil Co., Inc., Ohio Oil Co., and Stanolind Oil & Gas Co.

EAST COAST

Florida Test Put on Pump

MIAMI, Fla.—Pumping equipment has been installed and testing resumed at Commonwealth Oil Co.'s prospective oil discovery well 40 miles west of here in Dade County.

The well, 1 Wiseheart-State, which may open the state's second oil field, has been shut down since last November, when extensive swabbing tests failed to develop flowing production.

On the pump, the well produced 15 bbl. of net oil with 175 bbl. of water in the first 23 hours. Latest 24-hour gage was 192 bbl. of fluid with water yield down to 50 per cent. Drill-stem and swabbing tests prior to the well's shut down also indicated high percentages of water in fluid recoveries.

Prospective pay zone being tested is in the Glen Rose-Sunniland section, productive horizon of Humble Oil & Refining Co.'s Sunniland field, in Collier County, 40 miles to the west, and until now the state's only production. Interval testing is at 11,322-27 ft.

Coastal Caribbean Oils, Inc., and Gulf Refining Co. are joint owners with Commonwealth in the well.

North Carolina Test Spudded

RALEIGH, N. C.—Burton Drilling Co., Houston, is continuing its exploratory efforts in North Carolina with the starting of its second test, located 3 miles west of its first test, completed last September as a dry hole after drilling into basement rocks.

Locations of these tests are in Onslow County, in the southeastern part of the state, on the Atlantic Coast. The first test, 1 Hofmann Forest, in Section 8, Block 10, drilled to 1,570 ft. Tops of formations as reflected by the electric log were: Peedee, 444 ft.; Black Creek, 635 ft.; Eutaw, 731 ft.; Tuscaloosa, 1,208 ft.; basement rocks, 1,560 ft.

The second test is designated as 2 Hofmann Forest. E. T. Burton, Jr., and his assistant, A. B. Couts, are in direct charge of operations.

MID-CONTINENT

Brundred Properties Sold

TULSA.—William J. Sherry, Tulsa independent operator, has sold portions of the producing properties he acquired in the purchase last week of Brundred Oil Corp., Oil City, Pa.

Sherry bought all the stock of Brundred and liquidated the corporation the same day. Less than a week later producing properties in Anderson, Miami and Franklin counties, Kansas, were sold to Maracaibo Oil Exploration Corp. and to Climax-Molybdenum Co., New York.

Producing properties in Magoffin and Johnson counties, Kentucky, formerly owned by Brundred were sold to Harry W. Patterson, Buffalo, N. Y., and Gilbert L. Bright, Dallas, by Sherry.

Sherry retains ownership of the Garnett water flood property in Anderson County, Kansas, acquired from Brundred.

The transactions involved a consideration of about $3,500,000.

WEST COAST

Leasing Race Continues

LONG BEACH.—Approximately 22 per cent of the 1,800 parcels contained in the semiproved productive area underlying the city of Long Beach has been signed up for an undisclosed major oil company.

The firm of Keans, Springmann & Stipek is performing the leasing, offering a royalty rate of 25 per cent and an annual rental of $250 per acre for a maximum of 5 years.

Another anonymous oil company seeking to lease the 600-acre triangular area failed to follow through on a reported offer of 70 per cent royalty.

The latter development was made known by a committee of the Property Owners Oil Development Association at a meeting of 500 persons. By pooling their holdings the group is attempting to obtain more favorable royalty terms.

Dr. Russell Brougher, association president, said a new offer had been submitted but did not divulge its terms. He suggested the association hold out for a guaranteed 50 per cent oil royalty, with the developing company paying all costs from its share.

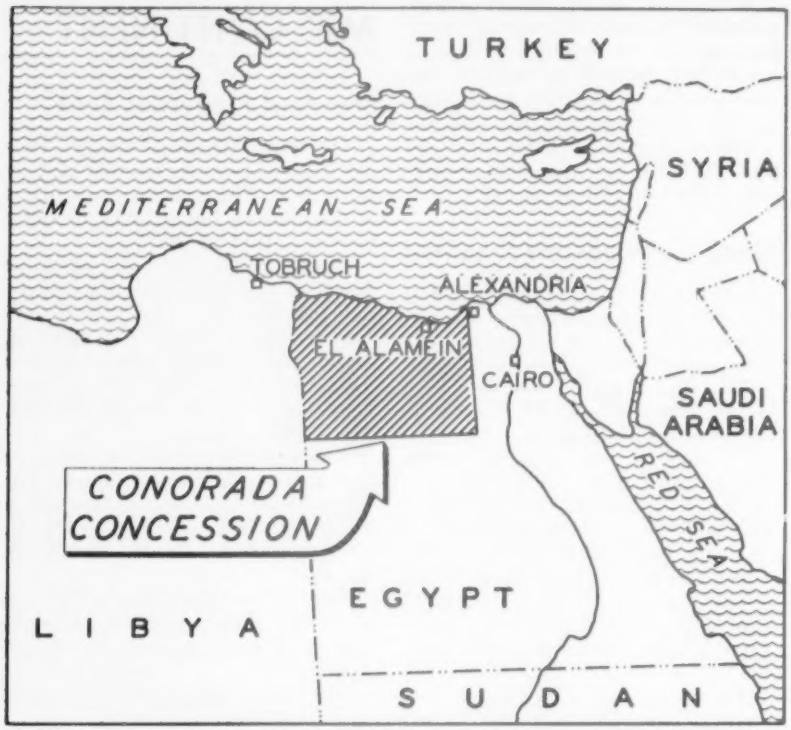
Since only the Ranger zone is expected to be productive in this area, engineers familiar with the zone's performance question the feasibility of a lease which entails a 50 per cent royalty payment. High development costs, involving slant drilling from a filled offshore island, they claim make such an offer uneconomical.

Drilling Rights Sought

LOS ANGELES.—Standard Oil Co. of California is seeking rights to erect a steel drilling platform 1 mile offshore from the city of Santa Monica to explore for oil in Santa Monica Bay.

In asking for drilling rights, Standard advised the city council that preliminary geophysical work has indicated an oil-bearing structure under the bay. The company said it is prepared to spend some $2,000,000 for the exploratory drilling.

Following Standard's request the council authorized the city manager to look into the situation from the viewpoint of beach pollution. Council members also declared they would favor competitive bidding for the drilling rights if other reports are favorable.



Desert Search Pushed

Conorada plans to start intensive exploration program immediately on 75,000-square mile Egyptian concession

CONORADA Petroleum Corp. is expected to start immediately on an intensive, long-range effort to find production in the 72,000-square mile Western Desert concession granted by the Egyptian Government.

Conorada is pledged to spend at least $8,000,000 in exploration during the next 6 years and intensive surface geology, photo geology, gravimetric and magnetometer studies should get under way soon. Some geologists regard the concession area as a part of a westward extension of the Persian Gulf geosyncline.

One attractive feature of the concession is its location. Fronting on the Mediterranean to the north, it has immediate access to the seacoast and is relatively close to major markets in Europe. Any production developed would carry a marked transportation advantage.

The total area involved is about the size of the State of Oklahoma. It extends from the thirtieth meridian westward to the Libyan border and from the twentieth-eighth parallel north to the Mediterranean, including territorial waters. Rommel's Afrika Corps fought across this part of Egypt, and along the coastal section are towns and villages made famous in World War II, including El Alamein, Sidi Barrani and Mersa Matruh.

Topography . . . Topography of the area varies. There are several relatively high hills in the south, and an extensive belt of shifting sand dunes east and south of the Qattara Depression. This offers some problems of transportation, but they are believed to be no greater than encountered elsewhere in desert oil operations. A macadamized road extends along the coast where the surface is generally rocky.

Previous exploration in recent years in the Western Desert was largely left uncompleted. Mediterranean Oil Co. (Royal Dutch-Shell) drilled a well in 1940 near Ras el Daba, ending in the Upper Cretaceous at 6,115 ft. The war brought an end to this program. Other drilling in the area consisted of a well near Mersa Matruh in 1932, abandoned at 2,240 ft. in what was believed to be the Cretaceous.

Several major companies carried out geological and geophysical work over parts of the Western Desert in the immediate postwar years. Among them were Standard Oil Co. (N.J.), Socony-Vacuum Oil Co., Inc., and Royal Dutch-Shell. This work was halted in view of the unfavorable legal situation created by the passage of the 1948 Egyptian mining law, along with the corporate law requiring majority stock offering to Egyptians and Egyptian directors.

One hazard encountered in this early postwar exploration was the presence of large numbers of land mines left by the military forces during the war. Some mines remain, but the fields are largely located and are considered to present no special obstacle to exploratory activity.

Early in 1953, the Egyptian Government issued a new mining law governing oil exploration and at about the same time abrogated the 1948 corporate law. This action of the government made possible a new interest in Egypt's oil prospects on the part of foreign companies. The 1953 mining law sought to encourage exploration of the Western Desert by more liberal terms for this region, and in Article 69, authorized the minister of commerce and industry, within one year, to set special conditions for exploration with individual companies.

Concession terms . . . The terms of the Conorada agreement follow provisions of the 1953 mining law. It is an exploration-exploitation concession with a 30-year life and renewable for 30 years under the same terms. The work obligations specify the minimum total expenditure with provisions for a progressive increase annually. Other terms include acreage surrender obligations.

The entire area is divided into square blocks each of approximately 430 square kilometers or about 166 square miles. If production is found, each exploitation block carries an annual rental of 25,000 Egyptian pounds, equivalent to $70,000, with other provisions for crediting royalty against the rental.

Royalty is established at a rate of 15 per cent, rising to 25 per cent 10 years after production is started. It is understood that the value of the royalty is based on the average export price at the main Eastern Mediterranean terminals for Middle East crude. As provided in

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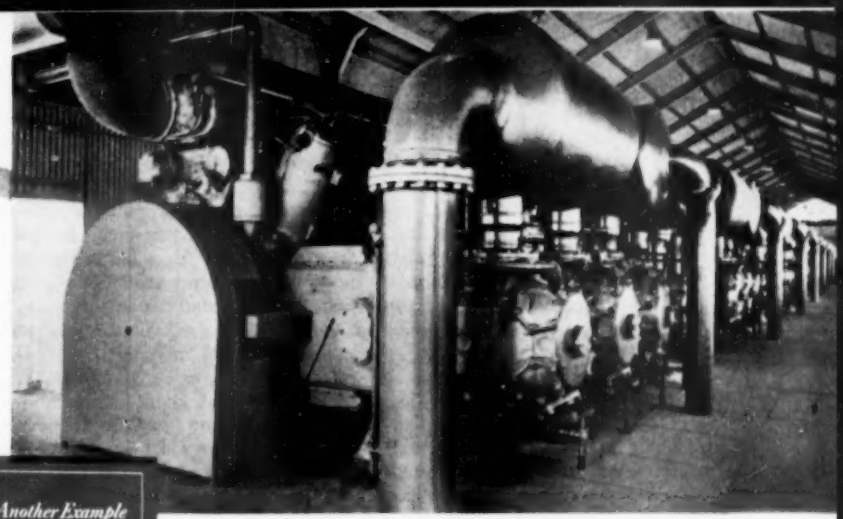

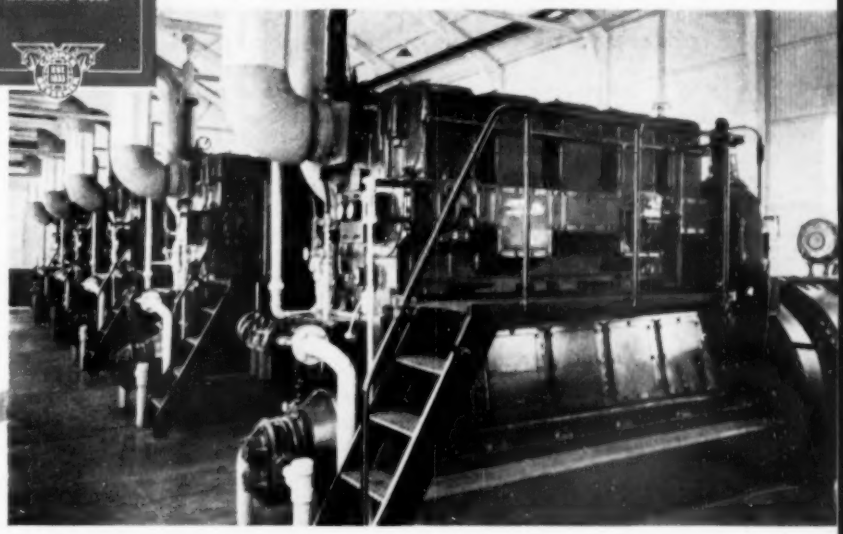

Above: Some of the Cooper-Bessemer GMV's, now totaling 13,200 compressor horsepower, in the Diamond "M" — Sharon Ridge Gasoline Plant, Scurry County, Texas. *Below:* In this same plant 6 long-lived Cooper-Bessemer 375 horsepower gas engines drive generators for all electrical power requirements.

• As shown opposite, modern Cooper-Bessemers team up to meet over-all power requirements at the Diamond "M"—Sharon Ridge Gasoline Plant, Scurry County, Texas. This plant now has twelve 1100 HP GMV's, each equipped with three compressor cylinders for 3-stage compression to 525 psi.

The companies participating in the Diamond "M" have had broad experience with GMV qualities—in other gasoline plants, in major chemical plants and *wherever* large scale compressing demands continuous, low-cost performance. That's one reason—experience—why GMV's were picked for this jointly owned operation.

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the law, the company is required to sell up to 20 per cent of its share of production to the government.

The mining law gives the company exoneration from import duties on the materials and equipment brought into the country. Egyptians must be hired in a 75-25 ratio to expatriate personnel, and the total wages and salary of the national employes cannot be less than 65 per cent of the over-all payroll.

Taxes and currency transfers are as provided in other Egyptian laws. The company is subject to normal taxes applicable to Egyptian industrial and mining undertakings, and under existing legislation, local currency profits can be remitted at a rate of up to 10 per cent of the investment annually, while the capital investment can be returned at a 20 per cent annual rate.

Egypt's present production of about 45,000 bbl. daily comes from several fields on either side of the Gulf of Suez. The operators are Anglo-Egyptian Oilfields, Ltd., and Socony-Vacuum Oil Co., Inc. Domestic output falls about a third short of meeting the country's internal requirements which are rising rapidly. Only other exploration in Egypt at present is by Southern California Petroleum Corp. as operator for International Egyptian Oil Co. in the southern part of the Sinai Peninsula.

Experts Tour Iran

British and American party touring Iran fields, Abadan refinery to determine cost of resuming oil operations

A PARTY of oil-company representatives left London last week for an inspection tour of the Abadan refinery and the Iranian fields as another step in the quickening progress toward settlement of the long-standing nationalization dispute.

The party of about 20 represented the British and American companies that have been meeting in London in an effort to work out plans for returning Iranian oil to world markets. These companies include Anglo-Iranian Oil Co., Ltd., Shell, Standard Oil Co. (N. J.), Standard Oil Co. of California, Socony-Vacuum Oil Co., Inc., Gulf Oil Corp., and The Texas Co.

The purpose of the trip was to give the engineers and technicians an opportunity to make a preliminary determination of the amount of money required for a resumption of operations. They were expected to be in Iran about a week. The ready acceptance of the Iranian Government to the suggestion for an on-the-spot inspection was in itself an encouraging development.

Aside from the question of the investment required to rehabilitate the facilities, industry and government officials working on the settlement plan face the necessity of devising some method of operating the properties that will satisfy still-strong Iranian nationalism and at the same time provide for efficient, nonpolitical management.

The plan for selling the oil involves the organization of a joint international group, or "consortium," of the eight principal companies operating in the Middle East. These large companies are the only ones with the extensive marketing organizations, particularly in the Eastern Hemisphere, where most of the Iranian output will be sold.

Operation is problem . . . The actual management and operation of Anglo-Iranian Oil Co., Ltd.'s nationalized properties appears to present a much more difficult problem. How far the Zahedi Government could go in allowing foreign control of the properties without serious internal trouble is, of course, not known. Iranians, however, are still deeply suspicious of any arrangement resembling the old concession.

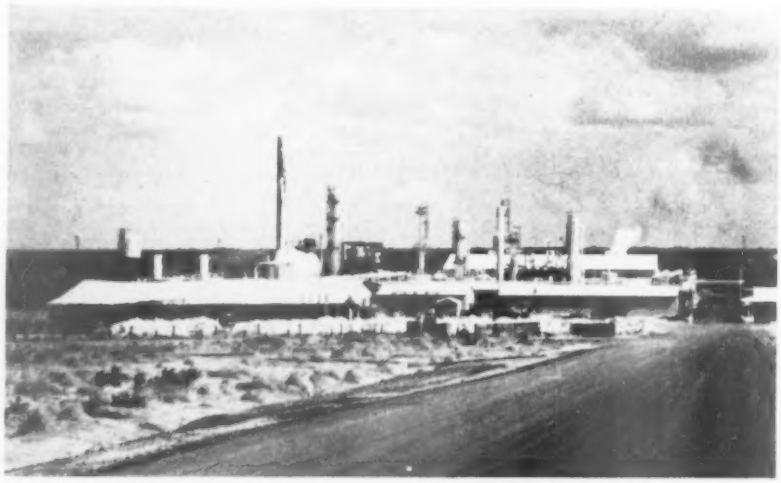
On the other hand, the companies undertaking to rearrange their supplies to accommodate Iranian oil in the now well-supplied world markets are expected to insist on some measure of control over operations. A competent management and assurances of long-term, continuing production are held to be necessary.

One pertinent point in this connection concerns the $75,000,000 to $100,000,000 estimated to be needed to restore full Iranian production after a virtual shutdown of close to three years. The international companies are not likely to advance this money without some form of management participation, or at least strong guarantees, regarding operations.

Although the Iranian public seems to understand that foreign technicians will be necessary to get the fields and plant running again, recent Iranian press reports indicate there is a belief prevalent that the major companies will simply send their tankers in to pick up oil at the dockside and that the necessary production will be funneled out by the National Iranian Oil Co.

In addition, many other complicated and difficult questions must be settled by the government negotiators meeting in Teheran, and by the representatives of the major oil companies presently holding joint discussions in London. Among these are the matters of British vs. American participation, prices at which the oil will be bought, and profits to accrue to the Iranians after compensation to Anglo-Iranian.

In London, it was said that the creation of a new international company composed of American, British, Dutch, and French interests offered a "fantastically knotty, technical problem." The



Mulata Plant Helps Feed Crude Lines to Puerto La Cruz

Cut out the trees in the background and this plant could be mistaken for an installation in West Texas. It is the Mulata stabilization plant of Creole Petroleum Corp. in Monagas in eastern Venezuela. Mulata field is one of a number in eastern Venezuela's producing areas which feed light crude into the pipe-line systems leading to Puerto La Cruz, a leading Venezuela export terminal. (Creole photo).

company delegations at the meetings included numerous legal, financial, and accounting experts.

Breakdown suggested . . . In a move to pave the way for the international marketing arrangement, the Iranian Government's oil advisory committee recently recommended that sales be made through American and British companies, and it was reported that the committee suggested distribution of 50 per cent of the production by United States companies, 45 per cent by British firms, and the remainder by Iran.

Another report from Teheran said the Zahedi Government intends that any final agreement will be in conformity with Iran's 1951 nationalization law and that it will not be necessary to submit the settlement to the Majlis, or lower house of Parliament. An oil agreement would be regarded as a commercial contract, thus avoiding the possibility of tying it up in months of discussion and argument. Parliamentary approval could take the form of a vote of confidence after the agrement is reached.

The diplomatic talks on oil currently taking place in Teheran are regarded as preliminary discussions. The London meetings concern only certain aspects of the over-all problem, and when these are concluded, a set of proposals presumably will be submitted which the Iranian Government can accept, modify, or reject.

T. Rieber, president of Barber Oil Co., who was retained by the Iranian Government as a consultant on petroleum, reached Teheran February 6. On arrival, he said he was "optimistic about finding a solution this time."

Dhulian Increases Output

Increased production from Dhulian field raised production of Attock Oil Co., Ltd., in Pakistan to 1,158,308 bbl. (about 3,170 bbl. daily) in 1953 as compared to 989,545 bbl. (2,700 bbl. daily) in 1952, according to a recent company statement in London.

The company reported that its Rawalpindi refinery operated satisfactorily during the year with a throughput of 3,075 bbl. daily on Attock's account and 1,079 bbl. daily for Pakistan Petroleum Ltd. The Attock company is adding to its tankage, and is studying the possibility of constructing a new 42-mile pipe line in the Punjab area where its production is situated.

Attock said that the flank well at Dhulian has reached 7,652 ft., and that another well is being deepened to the new zone. A location has been chosen and preparations are being made to drill another deep test in the Khaur field. The second well at Bains has reached 3,365 ft. after a sidetracking and redrilling job. In the Karsal area, structure work was favorable enough to warrant drilling a test to the limestones which are expected to be reached at about 11,000 ft.

New Line Studied

I.P.C. may divert unused Haifa pipe line to Lebanon

IRAQ PETROLEUM CO. LTD., is studying the possibility of diverting its long-unused Haifa pipe lines to a terminal on the Lebanese coast.

If carried out, the project would involve construction of a line from near Mafraq, Jordan, to a terminal in southern Lebanon, perhaps paralleling the Tapline for much of its length, and skirting Israel.

The system to Haifa formerly supplied the Haifa refinery of Anglo-Iranian Oil Co., Ltd., and Shell. The original 12-in. was laid in 1934, and a 16-in. was built postwar to within 50 miles of Haifa. However, the Arab-Israeli war interrupted the use of the system, and it has been out of service since May 14, 1948. The 16-in. is believed to be in good shape, but the condition of the 12-in. is doubtful.

The Iraq Government has asked I.P.C. to consider diverting the Haifa system in order to provide greater outlet for Kirkuk field. Kirkuk now produces nearly 500,000 bbl. daily which is moved to Mediterranean terminals in Syria and Lebanon through a 12-in., a 16-in., and a 30-32-in., the latter built 2 years ago.

The Haifa 12 and 16-in. have a combined design capacity of about 135,000 bbl. daily and any branch northwest across the southwestern corner of Syria and into Lebanon would presumably be able to carry this amount of crude. Mafraq in Jordan is a short distance east of the point where Trans-Arabian Pipe Line Co.'s Tapline crosses the Haifa 12 and 16-in.

One problem involved in the proposed diversion of the Haifa lines lies in the fact that the revised right-of-way agreements negotiated in 1952 with the Lebanese Government by both Tapline and I.P.C. have never been ratified. A recent report from Haifa said I.P.C. would carry out the diversion with a 20-in. from Mafraq to the coast as soon as Lebanon ratifies the 1952 agreement. However, it is understood that the proposal is still in a preliminary and hypothetical stage and had not progressed beyond informal discussions with the governments. For I.P.C., cost of the diversion, including terminal facilities in southern Lebanon, necessarily would be considered against other possible means of providing for the long-range expansion of Kirkuk's production.

Lebanese want more . . . The right-of-way agreements for the present pipe lines in Lebanon have become a political issue, and recently the Lebanese Chamber of Deputies unanimously passed a resolution for increased "royalties" from the two companies. The resolution declared a great injustice had been done the Lebanese treasury by the previous agreements. The Lebanese prime minister earlier told the chamber that the government was negotiating with the companies for higher payments and that the discussions were being carried out in a friendly atmosphere.

Neither Syria nor Lebanon have any production but the countries are crossed by lines of the two companies which lead to eastern Mediterranean shipping terminals. From time to time over the last several years, political figures in both countries have contended that, in exchange for transit rights, the countries should share in profits resulting from movement of crude through the lines instead of by tankers around Arabia and through the Suez Canal.

In 1952, the original agreements between the companies and Lebanon were renegotiated to give the government about 5,000,000 Lebanese pounds ($1,400,000) from Tapline and about 4,500,000 pounds ($1,260,000) from I.P.C. Later that year, the Lebanese parliament refused to ratify the revised agreements. The companies last year turned down a Lebanese proposal to reopen negotiations and are continuing to pay the governments at the rates provided in the May 1952 agreements. Fringe benefits bring the total paid by each company to better than $2,000,000.

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- **Extra-large, extra-powerful brakes cooled by enclosed circulating-water system**
- **2- or 3-engine drive with single or double pump drive**
- **Disconnecting Airflex clutch-controlled pump drives**
- **Big, strong shafts throughout; short bearing centers**
- **Engine compound and drawworks transmission clutches of disengaging spline type; master and high- and low-speed drum-drive clutches of extra-high-capacity air friction type**

The M-810 is a highly flexible rig that permits a wide latitude in the choice of engines and engine combinations. Moreover, it's designed for easy moving from place to place; the engine compound is a sectionalized type, and the width of the drawworks is well within required road limits.

You are invited to see and inspect this new, high-speed drawworks. Take all the time you want; there are many details you'll need to know, and we'll be glad to explain them fully.

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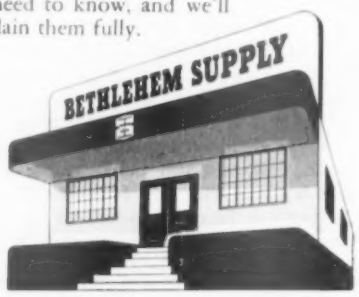

More Tests Planned

Australian discovery speeds up oil search; company which found oil plans three wells, other firms expect to drill

WESTERN Australia is going to have some more test drilling. Plans by the discoverers of the sensational 550-bbl. Rough Range wildcat, West Australian Petroleum Pty., Ltd., call for:

. . . **Another hole in** the "Rough Range" to test the Cretaceous series.

. . . **One hole in** the "Cape Range" to test the structure there.

. . . **One hole in** the Fitzroy basin.

The Rough Range discovery well itself has 13⅜-in. casing set and cemented, for testing and production, for the oil sand encountered between 3,605 and 3,620 ft. The casing is cemented at 3,862 ft. Production and tests have been made with formation tester, after perforating. The well has been drilling deeper to test further prospective formations.

A special report on the discovery well, located 22 miles south of Learmouth in Western Australia, was sent The Oil and Gas Journal last week by J. Bayliss, drilling consultant and equipment representative of Brisbane.

In his report Bayliss said:

"The flight from Sydney to Perth (about 2,350 miles) occupies about 11 hours, including a stop at Adelaide. A call was made on J. W. Thomas, general manager of West Australian Petroleum Pty., Ltd., at the Perth office of the company at 251 Adelaide Terrace, Perth, and Thomas very kindly gave approval for the visit, and assistance in securing air passage from Perth to Learmouth. The air company operating this line is MacRobertson Miller Airways, and the air-strip at Learmouth is what was known to the allied air forces as a "Pot Shot" air-strip.

"Business connected with the Learmouth air-strip is conducted by the oil company. The company has leased what were formerly air force huts, as all of the company's buildings which had been erected and were previously used had been blown away in the cyclone early this year. It is noticeable that the air force huts are anchored by wire lines attached to concrete deadmen.

"Rough Range, where the discovery well (Rough Range No. 1) is located, is distant from Learmouth about 22 miles.

"The entire drilling outfit is of American manufacture and the rig is capable of drilling to 16,000 ft. or deeper. The latest types of bits and core

barrels, cementing equipment, mud equipment and electrical logging equipment are used.

"A notable feature at the camp is the very high quality of food provided and the modern comforts and conveniences in the camp.

Additional exploration . . . "Back in Perth, W. A. Carcary of the firm of chartered accountants, Carcary, Halverson & Co., who is the secretary for Freney Kimberley Oil Co., stated emphatically that Freney Kimberly are going to drill a well. No decision had been taken regarding what rig they would acquire. Cyril Flower, of the firm of Flower, Davies & Johnson, 413 Murray Street, Perth, is chairman of directors of Freney Kimberley.

"It has also been stated that Frome-Broken Hill Pty., Ltd., will drill in the northern part of Western Australia. Frome-Broken Hill Pty., Ltd., is a combine of Anglo-Iranian, Socony-Vacuum and Zinc Corp. and holds extensive leases from north of Northwest Cape to Darwin.

"There are a number of other petroleum exploration ventures proposed or being promoted in Australia at the present time. These include Associated Freney Oilfields, a combine of Freney Kimberley and Associated Australian Oilfield, which has a nominal capital of £5,000,000; Cable Oil Syndicate, an all Australian organization with a nominal capital of £4,000,000; and Lucky Strike Drilling Co., an American organization which will operate near Maryborough, Queensland.

"And, the following persons and companies have applied for permits to explore for oil in Western Australia if any permits now held by West Australian Petroleum Pty., Ltd., revert to the Mines Department:

"Atlantic Union Oil Co., Ltd.; Australian Mining & Smelting Co., Ltd. (Frome-Broken Hill); Australasian Oil Exploration N. L.; Australasian Petroleum Refinery, Ltd.; E. Broughton Jensen; K. Cookson; T. R. Douthitt (U.S.A.); E. G. Locke; R. McLean; A. Schneider; Shell Co. of Australia, Ltd.; Vacuum Oil Co., Pty., Ltd.; and T. E. Eyres & Co., for Gold & Mineral Exploration, Blue Spec. Mining Co., and North-West Tantalum.

"Within the next 6 months or so, it is anticipated that very considerable activity may develop in Australia."

Field personnel . . . M. D. Kemp, petroleum engineer, is superintendent in charge of the field operations of West Australian Petroleum. Other personnel in the field are Charles Sloanaker, geologist; Don Stanley, geologist; J. Rice, toolpusher; Check Kemp, H. C. Burnside, Buck Helms, and Bob Alford, drillers; and Lee A. White, welder.

Brown Drilling Co., Long Beach, Calif., is the drilling contractor. Brown's drilling superintendent is Allen Dysart.

New refinery . . . Another important petroleum development in Western Australia is the refinery project of Australasian Petroleum Refineries, Ltd., at Kwinana, near Fremantle. Erection is being carried out by Kellogg International Corp. This will be a major refining installation and has a deep water jetty with three berths, each capable of taking the big new 32,000-ton tankers.

Two previous articles concerning the Western Australian discovery well, details of lease acquisition, geological structures in the Learmonth district, are covered in The Oil and Gas Journal issues of December 14, 1953, page 99, and December 28, 1953, page 60.

Refinery Plans Set

Ground to be broken this week for Puerto Rico plant

GROUND will be broken February 15 for a 10,000-bbl. refinery in Puerto Rico's Bayamon industrial area, 3 miles north of San Juan.

The refinery will be built by Caribbean Refining Co. and will cost an estimated $11,000,000.

It will process Eastern Venezuela crude and will market most of its products in the San Juan area.

Fluor Corp., Ltd., holds the construction contract. Design work was done by Universal Oil Products Co. Facilities will include fluid catalytic crack-

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ing, catalytic polymerization, gas recovery, and atmospheric and vacuum distillation units.

Caribbean Refining is owned principally by Pontiac Refining Corp., Corpus Christi; Gulf Oil Corp., Pittsburgh; and J. H. Whitney & Co., New York. Other stockholders include Ferre Industries of Puerto Rico; Emby Kaye, Tulsa; and H. M. Byllesby & Co., Inc., New York. Considerable financial support for the project was obtained from the Government Development Bank for Puerto Rico.

The refinery is scheduled for completion early in 1955. Most equipment is being purchased in the United States, with Puerto Rican suppliers being given preference on locally produced materials.

Caribbean Refining was organized nearly 3 years ago, but planning of the refinery was delayed by difficulty in obtaining a long-term sales contract for fuel oil, one of the refinery's principal products. Plans for the refinery were publicly announced last July *(The Oil and Gas Journal, July 20, page 87)*.

The new refinery will be the largest industrial plant thus far built in Puerto Rico by private capital. President of Caribbean is Edwin Singer, president of Pontiac Refining.

Progress Reported

Development of Brazil's oil resources said satisfactory

PROGRESS in the development of Brazil's oil resources and in the construction of additional refining capacity proceeded satisfactory during 1953, the Conselho Nacional do Petroleo reported.

The C.N.P. report, made public in Rio de Janeiro, said that exploratory tests had been undertaken in the states of Amazonas, Maranhao, and Parana and pointed out that the Nova Olinda wildcat south of Manaos had had core shows. In Bahia, where the present producing fields are located, new production was found at Catu at a depth of about 1,000 ft., and at Pojuca where the first well drilled revealed "extensive" producing formations at about 4,600 ft.

The attention of the government body has been directed to the states of Para Piaui, Sao Paulo, and Santa Catarina where preliminary work has showed several promising areas which will be drilled.

Contracts have been signed by the conselho with the states of Parana and Rio Grande do Sul for oil-shale development in the Irati district, in Sao Mateus and Sao Gabriel, respectively. C.N.P. also contracted with Foster Wheeler Corp. for the installation of a plant in the Paraiba Valley, State of Sao Paulo, which is intended to produce 10,000 bbl. daily from abundant shale deposits in that area.

It was estimated that the operations at the Mataripe refinery in Bahia resulted in a saving to the country of some $3,600,000 in the importation of petroleum products. During 1953, production at this refinery included about 360,000 bbl. of gasoline, 202,000 bbl. of fuel oil, and 26,000 bbl. of L.P.G.

Construction of the 45,000-bbl. daily refinery at Cubatao is moving forward. It is hoped that by July of this year the topping unit will be ready for operation with a capacity of 20,000 to 25,000 bbl. daily.

Douglas Starts Second Well

Douglas Oil Co. of California has begun a second exploratory well in the marine area off the Pacific Coast of northern Peru.

The well is on maritime zone concessions obtained by Petrolera del Pacifico with which the Douglas company has an operating agreement. It will be a 7,000-ft. test drilled from a beach location.

Douglas' first well, Lobitos 1, also is a directional hole from a beach location testing a 1,000-acre offshore block of Cia. Petrolera Lobitos. *(The Oil and Gas Journal, January 18, page 70)* Douglas also has an operating agreement with the Lobitos company.

Douglas announced in Los Angeles that Lobitos 1 is drilling below 5,119 ft. after pentrating two oil zones, one an 80-ft. interval from 2,520-2,600 ft. and the other from 3,370-3,500 ft.

Union Spuds Sechura Test

Commencement of drilling in its first exploratory well in Peru has been announced by Union Oil Co. of California.

The test, Paita 1, located a short distance from the coast northeast of Paita. The well is the third to be undertaken in the Sechura Desert of Peru on acreage taken after passage of the 1952 petroleum law. The first test, International Petroleum Co., Ltd.'s, Viru-4X-1, was dry at 7,330 ft. after entering the Cretaceous at 4,500 ft. Richmond Oil Co. (Standard Oil Co. of California) is now drilling its Inca 5 wildcat in the southwestern part of the Sechura.

The Union well is on Conorada Petroleum Corp.'s Block 1, originally taken out by Conorada whose acreage was subsequently acquired by Union. In Peru, Union has an operating agreement and management contract with Petroleo Sullana, Ltd., in which it holds 40 per cent interest.

Poly Unit Adds to Italian Expansion

One of the newly expanded, modern refineries in Italy is the Porto Marghera (Venice) plant of Industria Raffinazione Olii Minerali, with a crude capacity of 33,000 bbl daily. The view here is of the 400-bbl.-stream-day catalytic polymerization unit which was completed last August. Other facilities at the refinery and stream-day capacity include: reforming, 7,400 bbl.; coking, U.O.P., 600 bbl.; and lubricating-oil production, 250 bbl.; asphalts, 450 bbl.; and vacuum distillation, 7,000 bbl. in combination with one of the two crude units. I.R.O.M., the operating company, is owned 49 per cent by Anglo-Iranian Oil Co., Ltd., and 51 per cent by Azienda Generale Italiana Petroli.

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PERSONALS

Refining Executive

Brown takes over Caltex manufacturing operations

RUSSELL M. BROWN last week was appointed general manager of the refining division of California Texas Oil Co., Ltd.

The newly appointed general manager of Caltex refining has been working with refineries since he first helped to build one, in Texas, in 1928. Since then, he has been closely connected with all phases of their operation and management.

Born in Mason, Mich., August 13, 1902, Brown studied for a newspaper career at Ferris College, Big Rapids, Mich., then entered his family's newspaper publishing and job printing business in Ingham County, near Lansing. His switch to the petroleum industry came in January 1928, while he was traveling in Texas.

The Pasotex Petroleum Co. (now Standard Oil of Texas), a subsidiary of Standard Oil of California, was breaking ground for a new refinery in El Paso. Brown, who had worked during college vacations for the Michigan Highway Commission, was offered a job as a surveyor's assistant on the new project. He promptly accepted.

When the refinery went on stream, Brown joined the operations department, serving in successively higher capacities until in 1933 he was named chief refiner.

With this broad background, he was transferred in October 1936 to the Bahrain Petroleum Co., Ltd., as assistant superintendent in charge of the cracking units of Bapco's refinery, then being built on Bahrain Island, in the Persian Gulf. He arrived in Bahrain in February 1937. For the second time in his career, he appeared on the scene during construction of a refinery, it was an auspicious omen, for his subsequent rise was steady.

He became superintendent of the refinery in 1941; manager of operations in 1942; assistant general manager in 1945; general manager of operations in 1946, and vice president and general manager of the Bahrain Petroleum Co., Ltd., in 1951.

Brown returned from Bahrain in January 1954, to assume his new position as general manager of the Caltex refining division. The post involves coordination of the operation of the growing list of refineries in which Caltex has an interest. There are now 11 such plants, either operating or under construction.

Recently, Brown was awarded the honorary Order of the British Empire for his outstanding contribution toward international understanding between British, Americans, and Bahraini during his years as general manager of Bapco. In 1951, he was awarded the French Marine Marchande, a bronze medal for courage in marine rescue work. When two Air France airliners crashed in the sea off Bahrain, Brown organized and led Bapco tugs and launches in rescue operations. Twenty-one persons were saved and both planes were salvaged.

J. R. Keith has been appointed assistant general manager of the refining division of California Texas Oil Co., Ltd., with headquarters in New York. He has been on refining, research, and administrative assignments since joining The Texas Co. in 1929 and transferring to Caltex in 1937.

F. E. Caddy, Shell Chemical Corp. plant manager at Martinez, Calif., has become manager of the company's new plant at Norco, La. **C. H. Plomteaux,** formerly of the firm's manufacturing operations department in New York, has been named assistant superintendent. The Norco plant is now under construction and will produce allyl chloride and chlorohydrins. Caddy, with Shell since 1931, was appointed plant superintendent at Houston in 1948 and plant manager at Martinez in 1951.

William H. (Bill) McConnell has resigned as district geologist at Amarillo, Tex., for The Texas Co. to become a consultant. He has been replaced by **J. R. McMurry,** formerly at Abilene.

Dean B. Taylor, chief chemist for Phillips Petroleum Co. in East St. Louis, Ill., has been promoted to superintendent of the firm's pipe-line division in Missouri and Illinois with headquarters in St. Louis.

DOCKENDORFF

R. L. Dockendorff has been placed in charge of the process-engineering group in a reorganization of Humble Oil & Refining Co.'s engineering division at the Baytown, Tex., refinery. **J. J. Dvorak** has been placed in charge of the mechanical-engineering group, and **H. J. Mason** has been placed in charge of the project-engineering group. **J. W. Saunders** has been promoted to senior mechanical supervisory engineer. **J. W. Young** has been promoted to senior supervisory engineer, and **J. P. Mooney** has been promoted to engineering specialist in the design department.

J. J. DVORAK

H. J. MASON

Edward A. Morrison has been appointed geophysicist in the Denver office of British-American Oil Producing Co. He will be in charge of seismic interpretation and reinterpretation, supervision, and direction of the firm's field crews in the northwestern division exploration office.

E. J. Shimek, of Geophysical Associates, and former president of the Houston section, Society of Exploration Geophysicists, is one of the principals in a new seismograph company which has just been organized in Houston. Principal stockholder in addition to Shimek and his wife, is **Neal Clayton,** Tulsa, president. The new firm will be known as Liberty Exploration Co.

PERSONALS

D. C. Dunaway, executive vice president and a director of Standard Oil Co. of Brazil, has been elected president

H. B. WILSON

D. C. DUNAWAY

and a director of Esso Productora de Petroleo S.A., producing affiliate of Standard Oil Co. (N. J.) in Argentina. He succeeds **H. A. Metzger** with the producing company and assumes Metzger's advisory offices and responsibilities with other Argentina affiliates of Jersey Standard. Metzger is transferring to the U. S. to take charge of the New York office of Creole Petroleum Corp., Venezuelan affiliate of Jersey. **Henry B. Wilson,** formerly a director of International Petroleum Co., Ltd., also a Jersey affiliate, has been elected to succeed Dunaway with the Brazilian company as vice president and director. Dunaway has been with Jersey Standard and its affiliates in several Latin American and European countries since joining the organization in 1934. Wilson has been associated with the Jersey organization about 25 years.

Donald I. Lawless and **R. G. Russell** have been named managers by Bishop Oil Co. of the two divisions in which the firm's operational personnel has been organized. Lawless is manager of the firm's Mid-Continent division which includes Canada, and Russell heads the California division.

Joseph E. Carney, formerly assistant chief metallurgical engineer for Sun Oil Co., has succeeded **Dr. Aaron B. Bagsar** as chief metallurgical engineer. Dr. Bagsar retired February 1 after 22 years with the company. Carney joined Sun in 1934 and was appointed to his former post in 1951.

H. J. Hadow of the Department of Scientific and Industrial Research, has been appointed director of the United Kingdom Scientific Mission in Washinton and attache to the British Embassy. He succeeds **Dr. W. A. Macfarlane** who has been appointed general manager of the National Industrial Fuel Efficiency Service in London. The NIFES is a nonprofit company being formed by the British Productivity Council to provide general advice to industrial establishments on the most efficient use of all forms of heat and power.

George Grafton has been named district production superintendent at Continental Oil Co.'s new field office at Algiers, La.

W. K. (Bill) Barker, geologist, has resigned from Union Pacific Railroad Co. to become a consultant in Los Angeles. He also has been with Amerada Petroleum Corp.

Milton Young, petroleum-engineer trainee for Continental Oil Co., has been transferred from McAllen, Tex., to Ponca City, Okla.

John A. Faas, specialist in the design and construction of chemical processing plants, has been appointed chief mechanical engineer of Walter Kidde Constructors, Inc., engineers and builders.

Bob Field, consulting geologist, Denver, has joined with **F. A. Thurman** to do consulting geological work in the Rocky Mountain region with offices in Denver.

I. K. Nichols has been appointed geologist for Tennessee Production Co.'s southern division in Houston. **C. J. Hinshaw** has been appointed geologist at Wichita Falls, Tex.

George W. Atchley has been promoted by Republic Natural Gas Co. from Oklahoma district engineer at Pauls Valley to assistant district superintendent in the Hugoton, Kans., office. Prior to his Oklahoma position, he was field engineer in Republic's South Texas district. Atchley joined Republic in 1949 as engineer in the Dallas office.

R. L. Adams, Ardmore, Okla., has been promoted to the newly created position of assistant superintendent of Continental Oil Co.'s West Texas-New Mexico production division, with headquarters in Midland. **Jack Marshall,** Big Spring, Tex., assistant superintendent of Conoco's West Texas production district, succeeds Adams as South Oklahoma district production superintendent at Ardmore.

Robert D. Genesch has resigned as district geologist at Wichita, Kans., for Deep Rock Oil Corp. to become a consultant in that city. He had been with Deep Rock for 2½ years and also had been associated with Co-Operative Refinery Association and Stanolind Oil & Gas Co.

Joseph R. Mares, a vice president of Monsanto Chemical Co. since 1949, has resigned. He had been with the firm for 25 years and for 7 years was general manager of Monsanto's Texas division at Texas City.

George M. Washington, formerly assistant vice president of the oil development department of Northern Pacific Railway Co., has been placed in charge of that department, replacing **LeRoy H. Hines,** who recently resigned.

D. W. Bransky has been advanced from group leader to a research associate at the laboratories of Standard Oil Co. (Ind.), in Whiting, Ind. Other changes at Whiting include: **G. W. Schustek,** group leader to section leader; **J. O. Howe,** technical assistant to a technical associate; **G. C. Brooks, W. P. Cropper,** and **R. L. Menzl,** to group leaders; and **E. C. Gustely,** to laboratory foreman. At Standard's research laboratory in Neodesha, Kans., **O. A. Kozeny** has been promoted to group leader.

L. I. Brown has been named vice president and general manager of exploration for the California Co., with headquarters in New Orleans. Brown joined Calco in 1941 and has been manager of exploration since April 1953.

William F. Kirk, assistant director of the program division of the Petroleum Administration for Defense, has resigned to return to General Petroleum Corp. as assistant manager of the economics department in Los Angeles. He will be succeeded by **James S. Weatherby,** on leave from Atlantic Refining Co., Philadelphia, who has been chief of the division's domestic petroleum branch since last August.

Curtis M. Klaerner has been appointed manager of the Socony-Vacuum Oil Co., Inc. refinery at Buffalo, N. Y., replacing **Richard B. Price,** who has resigned to join Standard-Vacuum Oil Co. Klaerner joined Magnolia Petroleum Co., a Socony-Vacuum affiliate, in 1942. He was chief process engineer in charge of the planning and co-

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PERSONALS

ordination section of the technical department at Magnolia's refinery in Beaumont, Tex., at the time of his appointment.

G. A. Lorenz has been named assistant superintendent (administrative) of Shell Oil Co.'s refinery at Wilming-

G. A. LORENZ

L. J. SNYDER

ton, Calif. **L. J. Snyder,** head of the gas department at Shell's Houston refinery since 1949, has replaced Lorenz as assistant superintendent (operations).

H. W. Mathews has been promoted by Standard Oil Co. of Texas from production superintendent of the firm's western division at Midland to manager of the company's nonoperated joint-venture interests at Houston. He has been replaced at Midland by **J. P. Jones,** formerly district production superintendent at Snyder.

Joe H. E. Ward has resigned as division manager in Midland, Tex., for Ralph E. Fair, Inc., to become an independent consulting geologist. He had been with Fair for 2 years and prior to that had been division geologist in the Midland area for Mid-Continent Petroleum Corp.

Russel C. Conkling, formerly chief geologist for Plymouth Oil Co., resigned effective February 1 to join his sons, **Charles** and **Robert Conkling,** in the operation of Russel C. Conkling & Sons, independent oil operator in Midland, Tex. Conkling had been with Plymouth in Midland for the last 4½ years.

R. C. Quinn, district superintendent for Phillips Petroleum Co., has been transferred from Minden, La., to Smackover, Ark. Other personnel changes in the Phillips production department include: **F. G. Lyte,** from assistant superintendent at Minden to assistant at New London in the East Texas district; **Rue Mathews,** to district foreman in Smackover district; **L. A. Boyce,** to maintenance and well-service superintendent in Smackover district.

Bart de Laat has opened offices in Houston as a petroleum and natural-gas consultant.

William T. Eastes, party chief for Atlantic Refining Co., has been transferred from Anadarko, Okla., to Portales, N. M.

E. C. (Tex) Hartman, geologist with Cities Service Oil Co., has been transferred from Salt Lake City to Bismarck, N. D.

Porter Mitchell, geologist with Socony-Vacuum Oil Co., Inc., has been transferred from Kansas City to Bismarck, N. D.

J. E. (Jimmy) Sayre has joined St. George Oil & Gas Co. at Hurricane, Utah, as geologist and production engineer. He formerly was a consultant at Las Vegas, Nev.

Richard S. Mooney, Drexel Hill, Pa., has been appointed technical-service representative for Continental Oil Co.'s petrochemical department in New York.

Dr. K. C. Heald, who retired last June as vice president in charge of production for Gulf Oil Corp., has opened offices as a consultant in Fort Worth. Heald is a holder of the Sidney Powers Memorial Medal, the highest award bestowed by the American Association of Petroleum Geologists.

W. H. Carson, dean of the college of engineering at the University of Oklahoma, has been awarded an honorary doctor's degree by the Central University of Venezuela, Caracas. Carson was honored for his contribution to the education of many distinguished Venezuelan engineers.

G. W. Brock has been named district geologist at Midland, Tex., by Lario Oil & Gas Co., replacing **John W. Ruwwe,** who resigned to open offices as an independent geologist in Midland. Brock has been with Lario since 1951.

Oscar Arnold, formerly division production superintendent for Amerada Petroleum Corp. in Williston, N. D., has been transferred to Tulsa as head of a new partnership operations department which will supervise the firm's partnership transactions with companies. **Roy G. Fuller** has been advanced from district superintendent to replace Arnold. **B. J. (Brad) Sinex** has been promoted from district petroleum engineer to assistant production superintendent.

Thomas A. Hendricks has been promoted by Sohio Pipe Line Co. to engineer in the operating section of the firm's office in St. Louis. He joined Sohio in 1952.

Glen B. Gariepy has been promoted by Ohio Oil Co. from division geologist at Los Angeles to assistant division manager at Shreveport, La.

W. V. Grisham, formerly area engineer for Stanolind Oil & Gas Co. at High Island, Tex., has been transferred to Alvin, Tex.

Howard W. Haynes, formerly an engineer trainee for Gulf Oil Corp. at Tulsa, has been promoted to production engineer.

Gordon H. White, formerly president of Niloco Oil Co. and Niles Oil Co., Dallas, has become a geological consultant in Houston.

Fred D. Spindle, geologist with Ohio Oil Co., has been transferred from Fort Collins, Colo., to Lake Charles, La.

Frank Ficklin has resigned as engineer with Hiawatha Oil & Gas Co. to join the production department of Canada Southern Oils, Ltd., at Casper, Wyo.

Dolph Simic has resigned as vice president in charge of exploration for Bay Petroleum Corp. in Denver. He was associated with Cities Service Oil Co. for 11 years prior to joining Bay Petroleum 7 years ago.

Dr. D. P. Barnard, research coordinator for Standard Oil Co. (Ind.) in Chicago since 1948, has been sworn in as deputy to **Donald A. Quarles,** assistant of defense in charge of research and development.

N. E. Tanner, formerly Alberta Minister of Lands and Minerals, has been named president of Trans-Canada Pipe Lines, Ltd., the firm recently formed by the merger of the original Trans-Canada with Western Pipe Lines, Ltd., to build a big-inch natural-gas pipe line from fields in Alberta to markets in eastern Canada (*The Oil and Gas Journal, January 18, 1954, page 56*). Tanner will resign as president of Merrill Petroleums, Ltd., to take his new po-

PERSONALS

sition, but will continue with the Merrill firm as chairman of the board. **Frank Schultz,** who has been associated with the C. W. Murchison interests in Dallas with Delhi Oil Corp., and **H. R. Milner,** of Edmonton, have been named vice presidents of Trans-Canada.

Frank J. Spuhler, Jr., has been made assistant superintendent of the butadiene and butyl-rubber plants operated by Humble Oil & Refining Co. at Baytown, Tex., for the U. S. Government. He joined Humble's technical-service division at Baytown in 1939.

H. J. (Red) Magner has been promoted by Delta Drilling Co. to district manager at Bradford, Pa., replacing **W. H. (Bill) Young,** who resigned to join Case, Pomeroy & Co., Inc. Magner had been at Evansville, Ind.

Richard P. Nixon, who has been in charge of geological work at Russell, Kans., for Jones, Shelburne & Farmer, Inc., drilling contractors, has resigned to become a consultant there.

R. W. Hall has been appointed director of the technical and research division of The Texas Co. in New York. For the past 10 years he has been technologist in charge of the Houston office. Succeeding him in Houston is **C. P. Puryear,** assistant director in New York. **L. E. Endsley, Jr.,** is succeeding Puryear.

C. M. England, Union Oil Co. of California, Bismarck, N. D., has been elected president of the Dakota Geophysical Society. Other new officers, all of Bismarck, are: **Ralph H. Howe,** California Co., first vice president; **William Harley,** Hercules Powder Co., second vice president; and **E. B. Cole,** Cities Service Oil Co., secretary-treasurer.

Richard W. Camp, vice president since 1946 of Consolidated Gas Utilities Corp., Oklahoma City, will become president of the firm when the resignation of **Norman Hirschfield** becomes effective March 1. Hirschfield, with the company since 1938, will become president of S.N.G. Industries of Oklahoma City. **Curtis B. Day** will be advanced from general manager in charge of operations to vice president.

R. A. Slaton, who has been with Lone Star Gas Co.'s pipe-line department since 1935, has been promoted to construction foreman at Dallas.

P. A. (Dutch) Meyers, for the past 8 years exploration manager and chief geologist for **Claude B. Hamill,** has entered business as an independent operator and consulting geologist in Houston.

I. E. Nutter has resigned as general superintendent of manufacturing for Panoma Corp. in Amarillo, Tex., to engage in process consulting work for refineries and natural-gasoline plants. He also will continue operation of Nutter Engineering Co.

J. S. Rearick has joined C. W. Nofsinger Co., engineers and contractors of Kansas City, as manager of engineering. He previously was with M. W. Kellogg Co. for over 16 years as associate director research, development engineer, and division engineer.

E. E. (Tex) Francis has been transferred by William R. Whittaker Co., independent producing firm, from Los Angeles to Oklahoma City as production superintendent. **R. A. Buchanan** also has been moved from Los Angeles to Oklahoma City as manager of exploration, and **George R. Rainey,** formerly district geologist at Oklahoma City for Mid-Continent Petroleum Corp., has joined the firm as manager of the Oklahoma district.

Dr. Joseph Shoaf has been made chief process engineer at Suntide Refining Co.'s Corpus Christi plant. Formerly he was process engineer at Continental Oil Co.'s refinery in Ponca City, Okla.

James T. Gist, formerly manager of exploration for Pacific Western Oil Co., and **Louis B. Kellett,** district exploration manager at Midland, Tex., for Kerr-McGee Oil Industries, Inc., have joined Tide Water Associated Oil Co. as exploration geologists in the Midland district office.

Frederick L. Stead, formerly with Continental Oil Co. at Midland, Tex., has joined Ada Oil Co. as district geologist and manager of the company's newly formed West Texas division office in Midland.

C. H. Keplinger of Keplinger & Wanenmacher, Tulsa consulting firm, arrived in Colombia this week for a 3-week tour of Bogota and El Centro oil field. The firm is adviser to Empresa Colombiana de Petroleos.

DEATHS

Mrs. Mary Louise Brain, 87, retired Houston independent and one of the nation's few women wildcatters, died in Houston February 7. She entered the oil business in Humble field in 1921, and retired about 10 years ago. She had been associated with Brain Bros. Oil Co., formerly owned by her sons.

Fred B. Fleenor, 82, pioneer California oil man, died recently in Whittier, Calif.

James Hobart Hensley, Bartlesville, Okla., died recently at Topeka, Kans., following a long illness. He was with Phillips Petroleum Co. for 27 years, working in Oklahoma and Texas before returning to Bartlesville in 1942 as a member of the traffic department.

Carl Franklin Braun, 69, president and founder in 1909 of C. F. Braun & Co., which designs and constructs refineries and chemical plants, died recently in Pasadena, Calif., following a heart attack.

B. E. Walter, 80, pioneer Oklahoma oil man, died February 8 in Tulsa after a short illness. He was general superintendent for Homer Wilcox, for whom the Wilcox sand of Oklahoma was named, and Producers & Refiners Oil Co. before organizing B. E. Walter Oil & Gas Co. in the 1930's. He also was active in Glenpool field. Walter retired about 8 years ago.

J. W. Wiles, cable tool driller, died recently in Lansing, Mich.

Thomas M. Milling, 75, general attorney for Esso Standard Oil Co. at Shreveport from 1931 until retiring in 1943, died February 10 in Shreveport. He joined Esso in 1921.

John W. R. Crawford, Jr., 58, landman for Parker Drilling Co., died February 8 in Tulsa following a heart attack.

V. I. Cilley, 65, independent producer and lease broker, died recently in Grand Rapids, Mich.

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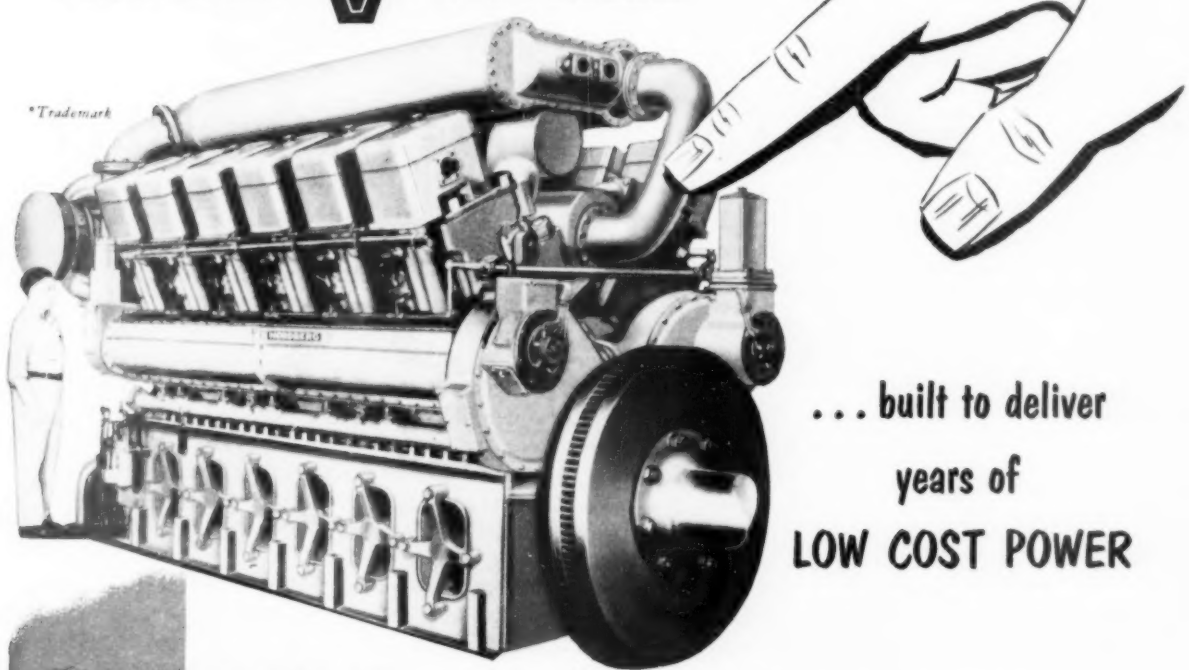

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COMBATING CORROSION ...A SPECIAL SYMPOSIUM

How 19 Companies Are Waging Attack

Between 30 and 40 per cent of the United States annual output of steel goes to replace losses by corrosion, it is estimated. The petroleum industry's share of this expense, added to other *direct* costs such as labor for repair and prevention, is in excess of $600,000,000.

To this figure must be added the less-tangible but indisputably real losses due to shut-down time, contaminated product, inefficient operation, lost production, and damage to producing formations.

While there is a need for better coatings, more resistant metals, and more efficient inhibitors, a better utilization of existing knowledge and products will help reduce the appalling waste caused by corrosion.

During the past December, approximately 150 representatives of operating oil companies and interested manufacturers met at University of Oklahoma. In a special corrosion-control short course there, 19 leaders in the field presented papers on the fundamentals of corrosion as well as practical aspects of protective coatings, cathodic protection, and chemical inhibitors.

The Journal, as a service to its readers, has compiled these papers and in cooperation with the university, presents them in this special section.

Where Does Corrosion Strike the Hardest?

by D. A. Shock

THE three major corrosive types of oil and gas production are classified as **condensate, sour crude,** and **sweet oil.**

For condensate corrosion the southwestern states—Texas, Louisiana, New Mexico, and Oklahoma—are the most important areas.

For sour-crude corrosion, West Texas-New Mexico and Kansas are in the forefront with Wyoming, Arkansas, and Mississippi much less prominent.

For sweet-oil corrosion a major problem exists in California and is developing in the Gulf Coast gas-lift wells.

Author is research group leader, production research division, Continental Oil Co., Ponca City, Okla.

Oxygen corrosion . . . Although the effect of oxygen in produced fluids is seldom considered a major corrosive agent on an individual-well basis, its economic importance is quite significant.

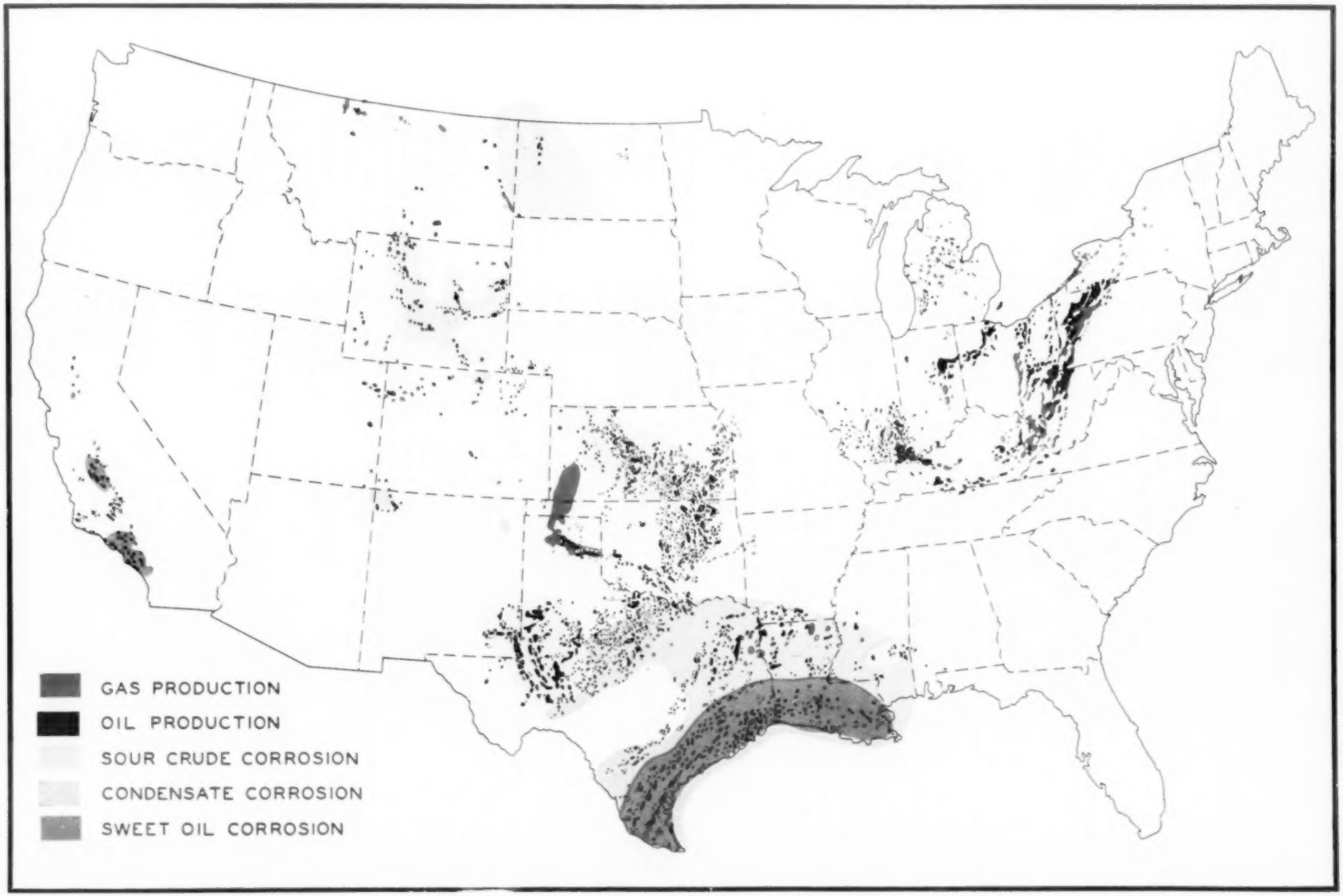
Oxygen is not found in the reservoir but comes from air being pulled into the producing system. This may come from faulty operation, old leaky systems, or be an inherent part of the operation as in open water-disposal and flooding systems.

The economic life of thousands of old shallow wells, many on stripper production, is definitely limited to how well oxygen corrosion has been controlled. Its effects can be mitigated by inhibition, by removal, or by exclusion.

Acid corrosion . . . The major recent advance in corrosive mechanism understanding has been in recognizing that the main anaerobic corrosion reaction is due to acid attack—acids produced by H_2S and CO_2 and the lower fatty acids dissolved in the water phase. These can occur singly or in any combination.

The corrosive types are classified by the manner of action of these cor-

CORROSIVE AREAS of oil and gas production in the United States



rodents and their relative concentrations.

Sour, sweet, condensate . . . The types of corrosive production fall into three general classes—sour crude, sweet crude, and condensate. In sour-crude corrosive production, hydrogen sulfide, H_2S, is found in the water. Sweet crude has no H_2S, and condensate production is that where condensed water and hydrocarbons are obtained through the retrograde phenomena.

There is considerable evidence that corrosion takes place by any of these acids at serious rates if the pH is maintained in the system at 4.0 or less. Carbonic acid is supplied in quantity by solution from the gas phase and is the principal source of the hydrogen ion to maintain this low pH, thus making CO_2 the most corrosive agent. This has been shown to be true even in the more corrosive sour crudes where hydrogen sulfide is normally considered the principal corrodent.

It is definitely true that the wells and fields which experience corrosion are those in which the acid environment is maintained. The factors which influence the rates of corrosion and severity of pit attack are dependent upon the ionic constituents in the water, the ratios of the various corrodents, the polar constituents in the oil, and the oil-water ratio.

Listed below are forms of well corrosion and the conditions that can be expected to bring them about:

1. **Very severe pit corrosion:**
   pH of water at well condition less than 4.0.
   High fatty acids, CO_2 + 1 atm. (partial pressure) (if H_2S is present).
   CO_2 — H_2S ratio such that CO_2 considerably higher than H_2S (2—1).

2. **Severe pit corrosion:**
   pH at well condition less than 4.5.
   CO_2 about 1 atm. (partial pressure).
   H_2S absent.

3. **Moderate general corrosion:**
   pH of water at well 3.5.
   High fatty acid.
   CO_2 — 0.2 atm.

4. **No corrosion:**
   pH at well condition greater than 6.0.
   Fatty acids, 0.
   CO_2 less than 0.2 atm. (partial pressure).
   H_2S absent or present seems to make little difference.

Corrosive Behavior of Production Methods

In condensate wells, corrosive action takes place in the condensed water layer which is swept up the tubing, as Fig. 1 illustrates.

The pressures from bottom hole to top do not drop appreciably and the solubility of the CO_2 remains high. Thus, a complete reaction of all the corrodent in the water with the metal is effected and a disastrous, severe pit attack results.

There is little difference between downhole and tophole rates and coupon corrosion measurements reflect with fair accuracy the corrosive behavior of the tubing.

High formation water production can result in a **more generalized attack** so the time to failure may not be as short with pitting.

Where the production rate is restricted and bottom-hole chokes are set, a condensed water zone may exist above the choke. The production rate is so slow that the water is not rapidly swept up the tubing, and a very severe pit attack occurs just above the choke.

The attack is not reflected on the surface by coupon exposures, and caliper surveys or down-the-hole coupons are the only useful methods of evaluating this condition.

Pressure difference . . . In oil production the fluid column is ordinarily sufficiently high to make a large difference between the bottom and top-hole pressure unless the reservoir is completely depleted. Moreover, temperature differences are greater, and this makes possible a considerable variation in pH of water where acid gas (CO_2 and H_2S) contributed to the acidity.

The water which is produced does not continuously contact the pipe. The acidity of the water is greatest, therefore, in the lower part of the tubing; and the reaction with the iron depends on the total amount of water contacting the pipe.

Thus a well does not begin to show the effects of corrosion until sensible quantities of water are being produced, and these evidences are **not** shown in the surface conditions so that surface coupon rates are of little value in correlating actual damage rates.

Since considerable quantity of water must be produced before corrosion takes place, the iron contents of the water are usually low even in very corrosive wells, and this corrosion criteria is difficult to interpret. Experience in interpreting surface evaluation, down-the-hole coupons, well service records, e.g., rod and pump repairs, etc., and tubing calipers have to all be used for proper evaluation.

A large subclass of oil wells where corrosion is reaching economic significance is the deeper wells being produced by gas lift. Here, while the general principles of corrosive attack are the same as in corrosive oil wells, the placement of gas-lift valves for artifi-

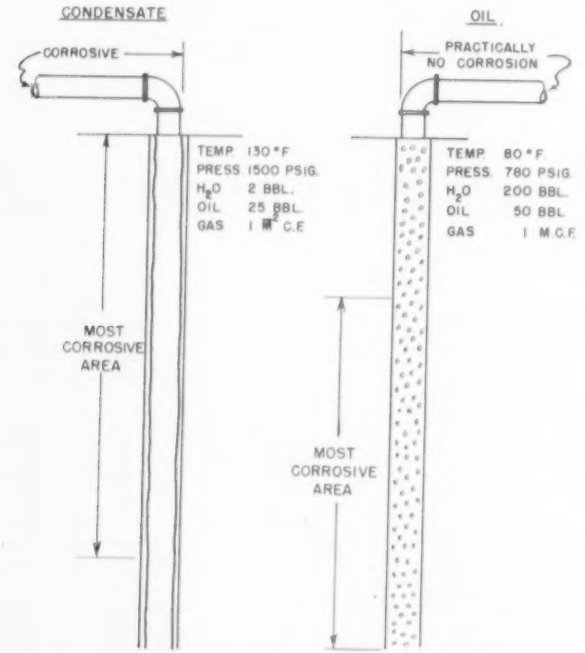


Fig. 1—Corrosive behavior of oil and gas wells. Depth 7,500 ft. gas 2 per cent CO_2; fatty acid 150 p.p.m. as propionic.

cial lift results in numerous treatment problems.

If the usual liquid inhibitor methods are used, the inhibitor must be so formulated that it will not react with the produced fluid and become ineffective, nor plug the gas-lift valves. If the valves are set off bottom the liquid must fall through the oil and water in the annular space. The tendency to produce the inhibitor through the gas-lift valves at the operating level leaves the lower, most corrosive portion untreated.

Difficulty in treating high fluid level wells can also occur in pumping wells.

Corrosive Areas

The large area in the eastern United States—New York, Pennsylvania, West Virginia, Kentucky, and Ohio—contributes only about 1 per cent of total oil production but accounts for 32.9 per cent (+150,000) of the wells. These and the older, shallow wells of Illinois, Indiana, Oklahoma, Texas, and Kansas compose the vast number affected by oxygen corrosion.

Many of these wells are so depleted that treatment and remedial measures are not economical. However, effective inhibitor methods are now available for oxygen corrosion, and all mechanical measures should be taken to exclude air. Thus, the recoverable oil from many of our present wells can be extended by using proper corrosion preventive measures.

Condensate wells . . . The most expensive and disastrous corrosive attack which takes place in production practice is in condensate wells. Research effort has made it possible that condensate corrosion now can be predicted with fair accuracy and numerous methods are available for controlling its progress in a wide variety of mechanical systems.

The majority of the condensate wells are in the southwestern states—Texas, New Mexico, Oklahoma, Louisiana, and a few in Arkansas, Mississippi, Colorado, and California.

Twenty-seven operators reported on 2,466 condensate wells in the southwestern area shown on the map.[1] Of these, 1,132—or 46 per cent—were considered corrosive.

This survey concluded that an average cost of uncontrolled corrosion in corrosive condensate fields was approximately $4.27 per M.M.c.f. and that the annual corrosion cost for uncontrolled corrosion would amount to $12,000,000 per year.

The average cost for chemical treatment was $0.25 to $0.75 per M.M.c.f. Thus corrosion control by chemical means can mean a direct savings of about $10,000,000 per year as well as intangible benefits in loss of reserves and reduction in hazardous operation due to blowouts and subsequent loss of equipment and personnel.

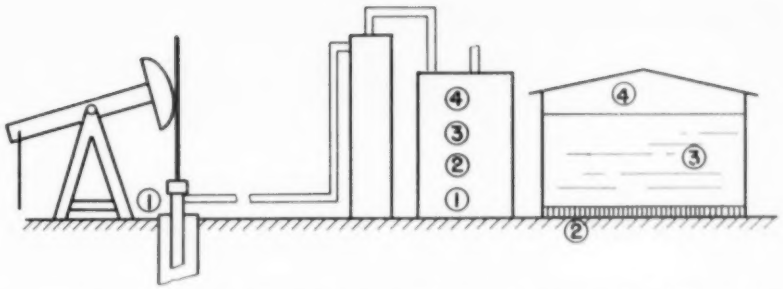


Fig. 2—Corrosive zones in sour-crude production. Zone 1 is mixed produced fluid environment where tubing, sucker rods, and flow lines are contacted. Zone 2 is the water zone after oil separation, Zone 3 the oil zone, and Zone 4 the vapor space.

Sour-crude corrosion . . . The oldest of the recognized corrosive oil production types is sour-crude corrosion. Sour crude differs from the sweet oil and condensate corrosion in that not only does it corrode the subsurface equipment, but also all handling, transporting and refining phases.

Fig. 2 illustrates the corrosive zones in sour-crude production. Zone 1 is the mixed produced fluid environment where tubing, sucker rods and flow lines are contacted. Zone 2 is the water zone after oil separation, Zone 3, the oil zone, and Zone 4, the vapor space.

Zone 1 corrosion severity depends on the amount of water and its pH, as does Zone 2 if oxygen is excluded.

Hydrogen embrittlement and subsequent fatigue failures are not eliminated even in alkaline atmospheres, and if air enters the system corrosion is severe.

Zone 3 is ordinarily the least corrosive although hydrogen blistering of steel tanks is quite common. This is due to atomic hydrogen entering the steel and collecting at barriers in the metal structure as molecular hydrogen. Sufficient pressure results to disrupt the metal.

Zone 4 corrosion takes place in the vapor space. H_2S vaporizes with the gas from the crude and dissolves in the condensed droplets on the tank decks, forming iron sulfide. The corrosion is particularly severe when oxygen is drawn into the tank as during "breathing." Oxides and free sulfur also are formed.

West Texas and New Mexico . . . While the sour-crude areas are quite alike in corrosive attack in handling equipment there is considerable difference in the corrosion in Zone 1.

Very little work has been done to explain the apparent lack of corrosion attack in some of the sour crudes, but the wetting characteristics of the oil and pH of the produced waters can account for the low corrosion rates of some West Texas crudes.[2,3]

The fact that some of the West Texas waters are noncorrosive plus the fact that many of the sour wells do not yet make water, lessens the total corrosion problem. Thus not all sour production and wells give corrosion difficulties.

Kansas sour fields . . . The sour production in Kansas on the other hand is quite uniformly corrosive through the state. There is little or no noncorrosive sour crude. The wells make water almost at start of production which makes them corrosive. Corrosion very often causes abandonment of a well in this area.

Wyoming sour crude . . . The sour-crude production in the Wyoming-Montana fields not in the Williston basin suffers from surprisingly little cor-

TABLE 1—ESTIMATED SOUR PRODUCTION IN UNITED STATES

	Production 1952 (1,000 bbl.)	Number of wells	Per cent U. S. sour production	Per cent U. S. sour wells
Arkansas	6,380	790	2.4	2.2
Indiana		544		1.5
Kansas	54,600	10,450	20.6	29.6
Mississippi	3,300	140	1.2	0.4
New Mexico	32,772	3,723	12.2	10.5
West Texas	160,525	19,187	60.4	54.5
Wyoming	8,500	427	3.2	1.2
Total	266,077	35,261		

rosion. In our studies of the fields, this is due to two main factors. One, the pH of the produced water at well conditions is relatively high. The produced waters are often saturated with sodium bicarbonate which limits the pH, even when there is considerable CO_2 present in the gas.

The other factor is that the majority of the wells are not making sensible quantities of water. It is anticipated that as water encroachment increases and also as greater pumping loads are put on the equipment, internal corrosion of tubing and increased fatigue failure of rods will become more common.

Other sour crude . . . In Arkansas and Mississippi sour distillate wells are particularly corrosive. The pumping wells in Arkansas are known to be corrosive. The sour corrosion noted in Indiana possibly comes from H_2S being formed by bacterial action on the sulfate in the old wells. The corrosion difficulties in operating these old, low-capacity wells definitely limit the economic recovery of oil in the area.

It is becoming evident that some of the Williston basin production is sour. This area is a large potential source and proper corrosion control from the inception of the field will be important.

Sweet-Oil-Well Corrosion

The most recent corrosive classification to be recognized is sweet-oil-well corrosion. This recognition springs out of the realization that the same corrosive reactions noted in condensate wells were taking place in our deeper oil wells when they produced water and sufficient CO_2.

From data developed by N.A.C.E. TP-IC it is evident that a few wells on the Gulf Coast experience a type of corrosion termed **high-pressure or water-independent sweet-oil corrosion.** Numerous wells, however, throughout the United States are experiencing CO_2 corrosion termed **low-pressure water-dependent sweet-oil corrosion.**

Bilhartz and Lonchric[4] have recently reported on the mechanism of the water-independent variety which requires a $CaSO_4$-$BaSO_4$ scale be laid down and then slowly hydrolyzing to give severe pit attack under the scale. These conditions as yet seem to be present in relatively few wells.

From our own work as well as the N.A.C.E. TP-IC committee work, we are convinced the low-pressure sweet-oil corrosion constitutes one of the coming major corrosion problems to the producing oil industry.

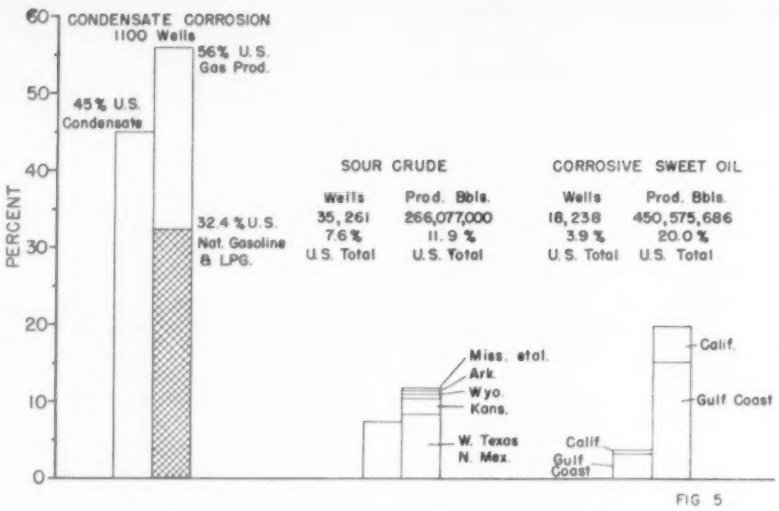


Fig. 3—United States corrosive gas and oil production.

Gas lift . . . Because of the nature of produced gas and the composition of deep formation waters, oil being produced from 4,500 ft. and deeper on the Gulf Coast can be expected to become corrosive. Moreover, when these wells stop flowing they are often gas-lifted, usually when more water than oil is produced.

The assumption that the wells on artificial lift were probably those which were corroding was found to hold true in a number of our fields and agreed with the general data collected by N.A.C.E. TP-IC.

The number of wells and production was tabulated from the A.I.M.E. Production Statistics for 1952 for the Gulf Coast from Texas through Louisiana. This tabulation showed that 15,788 wells were potentially corrosive, 4,073 probably now corrosive, and the corrosive production for 1952 of the 15,788 wells was 358,000,000 bbl., or 15.9 per cent of United States production.

Thousand dollars each . . . Experience on our wells showed that uncontrolled corrosion cost us approximately $1,000 per well per year. In other words, the industry faces a $16,000,000 corrosion bill, unless adequate corrosion control is found.

California, other areas . . . Outside the Gulf Coast the largest known sweet-oil corrosive area is the California production in the Los Angeles Basin and San Joaquin Valley. Deep wells, high-water production, and high-stress levels on the rods make for pump corrosion and rod breaks especially. In general, the waters are very high in organic acids as well as sensible quantities of CO_2. The corrosive attack differs from that found in the Mid-Continent and Gulf Coast areas in that the pit attack is less severe and that attack is more restricted to rods and pumps.

Some of the oils are high in polar constituents and it has been demonstrated that very high water cuts are required before the water will wet the tubing. It is felt that this is responsible for much of the difference in appearance of the corroded metal. Mild-to-severe attack due to CO_2 has been noted in the deeper producing wells in Oklahoma and Kansas. It is anticipated that this will increase as water increases.

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COMBATING CORROSION . . .

How to Get More Value From Paint

. . . in corrosion-mitigation programs

by William T. Thies

THE obtainment of full value for every dollar spent for protective coatings involves these things:

1. Careful selection of the places where protective coatings will be of value.
2. Proper materials for the job.
3. Proper application.
4. Evaluation of past unsuccessful jobs.

The selection of places where protective coatings will be of value is dependent upon the replacement cost of the item or structure to be protected, and the expected life without the coating opposed to the expected life with the coating.

The expected life with and without protective coating is a variable that all would like to be able to determine with certainty, but at the present time few are able to do so.

The value from paint in corrosion work presents a problem that can be considered along these lines:

1. The surface to be finished.
2. Method of application.
3. The environmental conditions.
4. Economics.

The surface to be finished means the kind of base metal, whether it is new or weathered, whether it is painted now and if so, its conditions, or if it is shop coated?

Shop coating, unless good materials are used and unless applied with a knowledge of the end use of the steel, is generally an expensive process; poor shop coats have to be removed to insure a lasting job.

Essentially, a good part of the success or failure of a protective coating depends upon the film—that is directly over the base metal. A great many shop coats are infinitely worse than nothing at all. Therefore, supplying the fabricator with first-coat paint of a type you want will often prove a wise investment.

The film next to the base metal could apply to many other materials—dirt, grease, rust, etc. If you have clean metal, you eliminate a known hazard. It seems to be an unfortunate fact that those paints that usually speed up finishing operations also require the cleanest surfaces.

Obviously, if you apply finish coats over the loose films, you have no bond to the firm base underneath unless your material will stay open or stay wet long enough so that by a combination of capillary attraction and solvency it can literally incorporate the dirt into the film itself, while the vehicle makes a firm bond with the metal underneath.

Method of application . . . There are a number of methods by which protective coatings may be applied; and excluding the fact that a user may or may not have a free choice as to the type of application, there are some very definite advantages and disadvantages to each. Brushing is one of the oldest and most widely used applications and oftentimes, the best. It is generally conceded to be the best for first-coat application from a performance standpoint.

Brushing tends to work the new coat of finish into the substrata and if there is some dirt, dust, or loose particles on the substrata, it tends to pick them up and work them right into the film and get the firm bond that is necessary. The fact that it is slower and a hand operation usually allows good work around rivets, angle iron, etc., that are often focal points for corrosion.

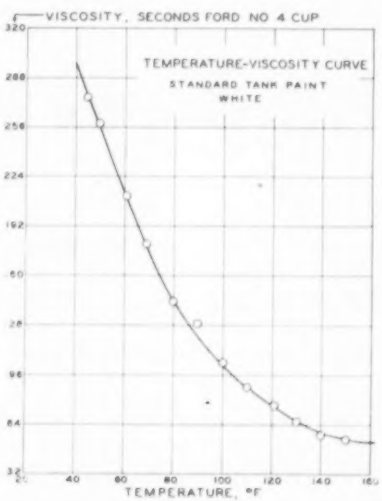

Fig. 1—Temperature-viscosity curve, standard tank paint, white.

Spraying . . . There are several types of spray systems available, one of which is conventional or cold spraying. However, the system of hot spraying takes advantage of the fact that viscosities of most paint-type materials drop rapidly under the influence of heat, as may be seen in Fig. 1. From there on, viscosity drops are quite rapid. By taking advantage of this viscosity drop, it is possible to apply much heavier films per pass of a gun than it is possible with cold spraying. Overspray and solvent losses are cut down.

On the other hand, for most exterior jobs, certain extra equipment is required and guns are a little more difficult to handle. Improvements are being constantly made and consideration should be given to it, as in the long run it may save money.

Airless spray is a new application that puts paint under high pressure and heat to force it through a gun with a slitlike nozzle. As it goes through the nozzle, there is a breakup of the material much the same as from a garden hose, but there also is a secondary breakup as the hot paint is released from pressure. The little droplets tend to explode into fine particles. Breakup is quite good. By this type of application, it is possible to lay on very heavy films, while the overspray is very small.

Roller coating finds its most promising application on large, moderately flat surfaces. Several steel storage tanks in one area have been painted this way. It isn't in common usage, but its use should expand.

Environmental conditions . . . Environmental conditions are a tremendous factor in corrosion protection. Some of the check points to consider would be:

1. Is it exterior or interior?
2. In what geographic area is it?
3. It is industrial or rural?
4. What special processes are nearby, that is, chemical plants, cement plants, etc.? And what is the direction of the prevailing wind?
5. Is it above or belowground?

Arthur is with Cook Paint & Varnish Co., Kansas City.

6. How much water resistance must it have?
7. With what liquids will it come into contact, either intentionally or by spillage?
8. Must it have heat resistance or resistance to cold or refrigeration?
9. Are there any other special things that will, because of the paint's location, put any particular strain on it, such as abrasion, flexibility, etc.?

The same paints don't stand up equally well in all locations of the country, particularly the narrow strip along the sea coast in the Gulf Coast region, one of the roughest corrosion areas in the United States.

From a practical standpoint, the user's experience, if he has kept records and really knows what his experience has been, is a most valuable tool in solving his particular problems. There is a fundamental need of most paint users—a department whose responsibility is the selection and use of paint, along with evaluation and recording of results. In order to get the most out of current purchases of protective materials and as an aid to bettering future operations, the primary efforts of the proposed department should be concentrated on the following points:

1. Good personnel for applying material.
2. Preeducation.
3. Good supervision.
4. Cooperation.
5. Specifications for finishing.
6. Record of operations.

Value of records . . . To a large extent, ability to predict how a project will go in the future will depend on how good a record was kept on past operations. In permanent records, note the location of the job (and this should be specific as to exact location within your plant) so that even 3 or 4 years later you can find it. If the job is a special test, it should have some special identifying mark on it, so that over-enthusiastic painters don't paint over test work that has been up for 3 years and is just starting to tell a story.

If there are any special conditions that make a job tough (just any direction from a cement plant, acid plant, caustic plant) mark it down in the record if you think it will have any bearing on a final outcome. You must also have a positive identification of finishing materials.

Temperatures ought to be listed to show the range during which paint was applied. When temperatures are low, dry times are slow, viscosities are heavy, and flow is poor, and many times condensation is heavy. As a result, paint jobs made during cold weather are subject to premature failure.

When paint is cold and heavy, it usually has to be cut with solvent in order to get workability. This necessarily lowers solids and resulting dry films are thinner than normal. Even though the paint is warmed up prior to use, it is difficult to get good workability in cold weather. If applied warm to a cold surface, the flow is stopped by the change in viscosity as the paint cools. Variations in film thickness inevitably occur and the life of a paint film is dependent on the thinnest part of the film.

Paint dry times vary with the moisture present in the air. When humidity is high, there is much more rapid corrosion of freshly cleaned areas; plus the fact that, sometimes, it may even lead to wet surfaces for painting.

Paints are amazingly tough and resistant films, and most corrosion engineers never see the film fail. They see paint pull away from the metal because of moisture—by underfilm corrosion—and the answer is not necessarily that "the paint failed."

It might be that the film failed, but also it might be poor cleaning, it might be poor metal preparation, it might be poor application. It might be that films were too thin, too thick, or that the paint wasn't stirred and all parts of the films are not pigmented alike. It might have been a frosty morning and the paint was put on over a wet, cold surface and it never did bond to the surface.

Pipe-line felt, shown here being applied to a large-diameter line, with glass wrap and other materials protect the enamel, which in turn protect the pipe.

Protecting the Protection . . .

on buried pipe line

by Frank B. Burns

IN the design of any pipe-line protection job we are concerned with the protection of the protection—those materials which afford protection to the pipe-line enamel. System No. 1, in Table I, is the basic corrosion protective system found on most buried pipe lines installed today. As may be seen, there are no auxiliary protective measures for the enamel in this system.

Whether this unprotected-enamel system or one of the protection systems is most desirable in the long run is a matter to be decided on the individual conditions of each job.

In some areas protective measures must be provided in addition to the coat and wrap in the form of a prefabricated rock shield, gunite or weight-

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ing material, kraft paper, whitewash, or selected earth backfill.

While gunite or weight coat are shown as protective materials for the pipe-line enamel, they are usually provided for the purpose of increasing the density of the pipe-line system so that it will remain submerged in swamps, lakes, or rivers when the pipe is empty. Such treatment is costly and, while it may provide excellent protection for the enamel, its added cost cannot be justified in most instances except where it is required to increase the specific gravity or density of the pipe-line system.

In the yard . . . In a stationary or yard-and-mill wrap operation, the individual joints of pipe are coated and wrapped without being welded together. After the coated-and-wrapped joints are welded together, the unprotected section of pipe around the weld must be protected by manually wrapping.

Where gunite or weight coating is required, it is customary to apply it at a stationary yard, subsequent to the coating-and-wrapping operation, and to permit the gunite or weight coating to set properly before transporting it to the pipe-line right-of-way.

In a field or over-the-ditch operation, the coating-and-wrapping machine moves along the line applying a uniform coating of the enamel to the primed surface and immediately applying the wrappings as shown in the numerically designated systems detailed in Table 1.

The coating may be applied as one coat or two coats. Where it is applied as two coats, the second coating application normally is carried out by the same machine which applied the first coating at a distance of 5 to 10 ft. behind the first coating.

All of the earliest auxiliary protective materials to be used on enamel-coated, buried pipe lines were asphalt or coal-tar-saturated rag-base pipe-line felts. These were conventional prepared roofing materials but due to today's requirements for a product suitable for mechanical means for coating and wrapping, the specifications on pipe-line felts have departed from those on regular roofing felts. Because of the susceptibility of rag or organic fibers to various soil bacteria, fungi, etc., asbestos-base felts were early tried and came to be widely adopted.

Glass mats to reinforce . . . Because of the manner in which pipe-line enamel must be applied, those enamels which were most readily and satisfactorily applied frequently tended to be somewhat brittle and to show cold flow. In an effort to overcome these deficiencies of otherwise very satisfactory pipe-line enamels, corrosion engineers explored reinforcing the enamel coating with functional fillers or specialized mats.

One of the most satisfactory means for reinforcing pipe-line enamels has been the use of so-called bonded fibrous glass mats embedded in the enamel. Originally, these bonded fibrous glass mats were formed merely by depositing a thin, substantially uniform jack-straw layer of glass fiber and binding these fibers together with a suitable thermosetting resin.

Due to the relatively fragile nature of such a mat, it has become common practice to reinforce this glass mat with glass threads, embedded in the jack-straw fiber as the mat is formed, first, in a random or swirl pattern but, more recently, in a straight-line pattern where the continuous thread is parallel to the length of the roll.

When this bonded fibrous glass mat for inner wrap became available, it was natural that the manufacturers of such products should attempt to use it as a base for making a pipe-line outer-wrap material, and today there is on the market a glass-base pipe-line outer-wrap material.

The protective materials are normally packaged in rolls of various widths and lengths, depending on the size of pipe to be wrapped and whether the wrapping is to be performed in a yard or over-the-ditch. It is customary to provide a certain overlapping of the wrap in successive convolutions, the amount of such overlapping being determined by the diameter of the pipe being wrapped.

The pressing needs for an economical prefabricated rock shield resulted in the trial and eventual adoption of a specially modified form of the so-called asphalt backer board. This product is normally supplied in sheet form, with scorings lengthwise the sheet to facilitate its application to the pipe line.

The usual practice is to apply the prefabricated rock shield to the pipe line, after it has been inspected for holidays and these holidays patched, by manually wrapping the sheets of rock shield over the coated-and-wrapped pipe and binding the sheets in place with steel bands or other suitable fastening means.

Due to the comparatively high strength and rigidity of this material, it provides a greater protection from rocks present in the bottom of the ditch or in the backfill and is adequate

TABLE 1—SYSTEMS OF PIPE-LINE PROTECTION

System—	Cleaned steel pipe surface	Primer	First enamel coat	Embedded glass mat	Embedded pipe-line felt	Second enamel coat	Pipe-line felt or glass base outer wrap
1. Unprotected enamel	X	X	X				
2. Single coat, single wrap	X	X	X	X			
3. Single coat, single wrap	X	X	X				X
4. Single coat, double wrap	X	X	X	X			X
5. Double coat, single wrap	X	X	X	X		X	
6. Double coat, single wrap	X	X	X		X	X	
7. Double coat, double wrap	X	X	X	X		X	X
8. Double coat, double wrap	X	X	X		X	X	X

Note: For specifications and testing procedures on wrapping material, refer to: "Asphalt Protective Coatings for Pipe Lines," First Edition, Asphalt Institute, 801 Second Avenue, New York; or to: "Standard Specifications for Coal-Tar Enamel Protective Coatings for Steel Water Pipe," 1950, American Water Works Association, Inc., 500 Fifth Avenue, New York.

TABLE 2—MILEAGE AND COST ESTIMATION TABLE FOR PIPE-LINE PROTECTIVE WRAPS

				Requirements and costs of wraps per mile		
Pipe size (in.):	Surface area of bare pipe (sq. ft./mile)	Width of wrap (in.)	Wrap lap (in.)	Squares of 100 sq. ft.	Glass mat costs*	Pipe-line felt or glass outer wrap costs†
4	6,220	6	1	78.0	$74.10	$133.38
6	9,158	9	1	106.9	101.55	182.80
8	11,922	9	1	138.4	131.48	236.66
10	14,860	12	1	166.5	158.17	284.71
12	17,624	12	1½	205.5	195.23	351.41
16	22,116	12	1½	258.0	245.10	441.18
18	24,881	18	2	285.8	271.51	488.72
20	27,646	18	2	317.3	301.44	542.58
24	33,175	18	2	380.3	361.29	650.31
26	35,939	18	2	411.8	391.21	704.18
30	41,469	18	2	474.8	451.06	771.31
36	49,761	18	2	567.0	538.65	921.09

*These cost figures are based on an average delivered cost of $0.95 per 100 sq. ft. †Based on an average delivered cost of $1.71 per 100 sq. ft.

in many locations for protection against such rocks without the necessity of using selected backfills around the pipe.

Additional protection . . . In yard-and-mill wrap operations, an outside wrapping of kraft paper is used purely as a sacrificial wrapping to protect the underlying coating and wrappings of the pipe during storage, handling to the job, and installation in the ditch.

In extremely hot weather or when using a relatively soft pipe-line enamel, it is frequently necessary to apply a whitewash compound to the coated and wrapped surface to radiate the sun's heat and thereby lower the temperature of the pipe to a safe working level. However, as noted under Table 1, some light-colored outer wrapping materials have sufficient reflecting power to eliminate the necessity for using a whitewash when such light-colored felts or wraps are used. Also, the presence of kraft paper on a pipe will normally eliminate the necessity for whitewash.

Where the size of rock or hard objects in the bottom of the trench or backfill is such that it is not felt that prefabricated rock shield will provide adequate protection, a selected backfill must be placed in the bottom of the trench before the coated-and-wrapped pipe is lowered. Sufficient additional selected backfill must be placed in the trench to provide a sidewall and top covering of at least 6 in. When this selected backfill is in place, the material originally excavated from the trench may be bulldozed back into the trench without danger of damage to the protective system previously applied to the pipe line.

Protection costs . . . The conventional usage data generally applied in estimating the quantities of the various pipe wraps or felts needed to wrap selected diameters of pipes are shown in Table 2. The delivered cost figures used are those current in the industry today for the most commonly used wraps, viz., 15 or 20-mil glass mats and 15-lb. felts or 12-lb. outer wrap.

It has been estimated that the overall cost of the recently completed Trans Mountain pipe line, extending from Edmonton, Alta., to Burnaby, B. C., a distance of some 715 miles, was about $93,000,000. The approved trunk-line tariff on its 120,000 bbl. per day is 45 cents per barrel or a total revenue of $54,000 per day.

The cost of the protective wrapping materials on this 24-in. line was approximately $723,293. If these protective wraps help avoid only 13½ days of down time, with the accompanying loss of revenue, it will have paid for itself. Savings in down time beyond this period, attributable to these protective wraps, will be handsome dividends on the investment in these protections for the protection of this pipe line.

Management's Stake in a Program Of Corrosion Mitigation

by Lewis Finch, Jr.

WHILE many protective measures to conserve metals are available, industry has been slow to use many of them. The next move is up to managements of all industries to take advantage of the tools made available by the corrosion scientists. The savings of steel should be given top priority because of the decreasing supply of raw materials and the great importance of it in our modern world.

The producing department of petroleum companies has to contend with corrosion in oil, water, and gas piping; in storage and process vessels; in engines and compressors, and in boilers and other equipment, on leases and in gasoline plants. But more challenging than all these aspects is the damage and the control of damage to subsurface equipment in oil and gas wells. This is because of the preponderance of investment in oil and gas wells, of the inaccessibility to the points of corrosion underground, and of the value of the oil and gas reserves controlled by wells. Seventy per cent of the producing-department investment of a typical large company is in wells and nearly a quarter of this in turn is in steel goods. Another 10 per cent is in gas plants and the remaining 20 per cent in other surface installations, mostly on oil leases.

Author is chief engineer, producing department, Stanolind Oil & Gas Co.

The oil industry has experienced a change that is not indicated by the fact that production has doubled since 1939—that it was 72 years from 1859 to 1931 before a well was drilled below 10,000 ft., and that many other physical changes have taken place. Ours is not the same industry as prewar, simply blown up to twice the volume. In many respects, it is an entirely new industry. It has new techniques, new problems, new opportunities.

Of more concern now . . . Looking at producing wells shows some of the reasons why management should be more concerned about damage caused by corrosion now than it was 10 to 15 years ago. The first reason is that wells are more expensive today, and the loss of a well from the standpoint of the drilling and equipment cost alone is more important.

In 1939, my company's average well was drilled to 4,800 ft. and the cost was $25,000. Some shallow wells cost as little as $2,000, equipped to produce. In 1952 our average well was drilled to 5,900 ft. and the cost was $85,000.

Secondly, at the greater depths encountered in today's wells, higher pressure and higher temperatures are encountered. This places a greater responsibility on well equipment, particularly casing, and it is extremely important that it not be weakened by corrosion.

Failure of such equipment may result in a blowout, an expensive repair, or even loss of a well. Third, generally speaking, more oil, gas, and water zones are penetrated in the deeper wells. This means more potential sources of corrosion and greater potential loss of reserves in multiple-pay fields in the event of a blowout. In many such cases, only one pay is produced at a time which means a longer producing life, especially under proration, since it will take as long to produce each of the zones as it would to produce a single zone in a well having one pay. This means that permanent well equipment in modern wells may not only be subjected to more severe conditions but also may be required to withstand these conditions for a longer period of time.

Fourth, in many multiple-zone wells, multiple completions are made in lieu of depleting each zone separately. Multiple-completion operations are difficult and expensive at best, and with corrosion thrown into this complicated setup, the cost of maintaining multiple completions can rapidly become prohibitive. Incidentally, application of known corrosion-mitigation methods to completions of this type is one of the major problems confronting the modern oil industry.

Fifth, secondary-recovery programs

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are being conducted in a rapidly increasing number of fields, extending the life of wells and in some cases, subjecting them to additional types of corrosion attack.

Carrying Out a Program

After development of the hydrogen sulfide corrosion-control method in the laboratory in 1944, the next logical step was field trials and proof of the effectiveness of the method. Since there were many details to be worked out in the field it was logical that the research man should go to the fields and help work out the details of application to be sure that the inhibitor was given a chance to do the job. This was done with a great deal of success and set the pattern for our present procedure of coordinating corrosion-control methods.

For simplification from the organization standpoint I will say we have three groups. First is the field group where the problems exist. Second, is the office group, including in our case district, division, and general offices. Third, is the research group.

The field group has the job of recognizing corrosion problems, applying mitigation methods known to be effective, and referring problems that it doesn't know how to handle to the office group.

The office group or possibly better, the coordinating group, acts as liaison between the research group and the field group, promotes wider application of known mitigation techniques, disseminates new information throughout the district, division or entire company, and refers appropriate problems to the research group for study and solution.

The research group, of course, works on the solution of new problems and the development of new or more effective procedures. The field group is furnished with results of the research work. Activities of the research group are not limited to finding a solution for recognized problems but a substantial amount of basic or pure research is done on corrosion, which is at it should be.

Didn't do the job . . . I doubt if the organization just outlined differs basically from that of any other oil company. However, we found that, while our setup was probably typical in a general way, it still wasn't enough to get the corrosion job done. The research group needs actual contact with problems in the field. To overcome this deficiency, regularly scheduled trips, either semiannually or annually, are made by our corrosion-research engineers to field locations which have corrosion problems. The research people are accompanied by a representative of the office group.

On these trips round-table discussions are held on corrosion difficulties at each location. Similar problems at other locations are reviewed, how they are being combated, and results. Many questions raised by the field man can be answered on the-spot; other require further study and are answered later by correspondence.

These meetings have served to stimulate a great deal of interest in corrosion among field personnel. In many cases, success of a certain program in one area has encouraged personnel in another area to support some corrosion-control measures and ultimately make it work, whereas otherwise it appeared the field tests would have been terminated as unsuccessful.

The office and research people in turn get a complete idea of what the field problems are and are in a much better position to develop and suggest corrective measures that have a chance of working. In these meetings a minimum of time is spent on doing actual routine field work normally done by field personnel. Just enough field work is done to be sure the field representatives know how to do their part of the corrosion job. A certain amount of routine educational work and training is essential since our engineers in the field are rotated on various jobs and do not stay on the corrosion assignment very long.

Field men attend . . . In addition to these meetings between representatives of various groups directly dealing with corrosion mitigation, corrosion conferences are being held in field offices with pumpers, head roustabouts, gang pushers, and other production men in attendance. A talk on the principles of corrosion is presented and samples of corroded equipment are shown. An outline of the lecture, complete with pictures showing typical examples of various types of corrosion, is given to each person who attends. At the conclusion of the formal presentation, a discussion period is held and everyone is encouraged to participate.

An attempt is made to correlate the information presented in the preceding talk with actual observation and first-hand experience of the field men in the meeting. This so-called educational program has done a great deal to gain the support and sympathy of the average field man toward minimizing corrosion losses and we feel has been very significant.

As a further means of promoting corrosion mitigation, we have prepared and made available at all field locations a comprehensive corrosion handbook or manual. This manual serves as a very useful guide to field men.

The basic plan of the meetings of the various representatives dealing with corrosion at field locations was in effect at the time Stanolind's producing and manufacturing operations were combined early in 1951.

What to consider . . . There are several things necessary to consider in placing a corrosion recommendation or program before management.

First, there is the matter of economics. Most executives live and think in terms of dollars and cents, cost and profit, when it comes to business matters. This is logical when one considers that the efficiency of management is judged by the stockholders in terms of ultimate net profit. It is the executive who must justify his actions when profits do not come up to stockholders' expectations.

You may agree that management is entitled to and needs a complete economic analysis but that it is very difficult to reduce recommendations regarding corrosion mitigation to a cost-and-profit basis. It is true that this is difficult, but it is not impossible.

For example, the first few wells in which we used formaldehyde to combat hydrogen sulfide corrosion were approved for treatment by management on an experimental basis with little supporting economics. This initial program was small and did not represent a sizable capital outlay — so management was willing to experiment. By maintaining accurate records on these initial wells, we were able to show savings on the order of $50 per well per month in reduced pulling expense and lengthened life of well equipment. At the same time we accumulated cost figures of equipping wells for injection of the inhibitor.

When it was desired to expand the program, the cost and profit figures that had been accumulated were used as a general yardstick to present management with a fairly firm economic analysis showing a good payout of the added investment. Management is ready to go if the economics are good.

Be sure of ideas . . . The second most important thing to do to gain greater support of management is to use all available facilities to be sure your recommendations are on firm ground. A few years ago insulating flanges in flow lines to oil and gas wells became very popular. Numerous articles appeared regarding their use in stopping flow of current from oil and gas lines into wells and consequent damage to subsurface equipment. Two or three

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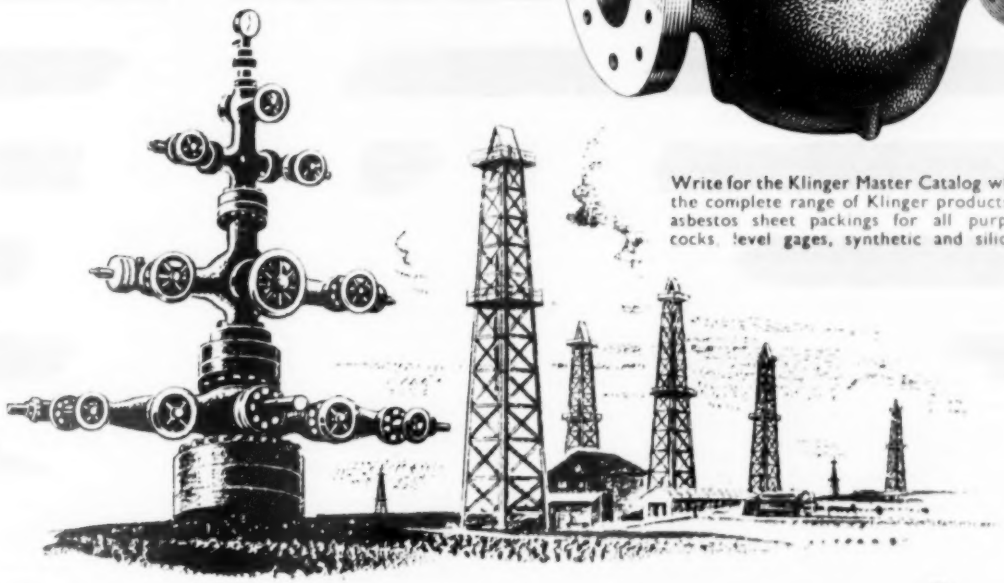

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supply companies were doing a brisk business selling insulating flanges to the oil people. We began to consider wide-scale use of insulated flanges.

However, before proceeding it was decided to get a report from our research laboratory. Research came up with a startling fact—no technical literature indicated research had actually been done on the effectiveness of insulating flanges. Someone had thought of the idea of an insulating flange several years earlier, had installed them in flow lines, and someone had written an article about it.

The idea seems so simple and so logical that it caught on rapidly and was soon pretty well accepted as a good idea throughout the oil industry. Fortunately, the illustration I use had a happy ending, but the fact remains that an unproved idea gained wide acceptance. It could just as easily have turned out to be a poor practice. A bad experience of this magnitude would have greatly reduced management's confidence and interest in corrosion mitigation in general. You should make certain that new ideas are adequately tested in the laboratory and in the field and that all possibilities are considered before large scale application is recommended to management.

Third, all concerned should strive for better cooperation and understanding between field, office and research engineers.

Basic research needed . . . A fourth need is for much more basic research to develop more effective and less expensive means of controlling the variety of kinds of corrosion. This can be done by individuals within their own organizations. Another approach would be to encourage or sponsor corrosion research programs in colleges and universities.

I would like to emphasize one phase of research that is particularly important. That is the development of additional and more accurate methods of determining the presence and extent of corrosion. Of utmost importance is the need for improved methods of diagnosing the occurrence of internal and external casing corrosion. With better methods of spotting corrosion in its very early stages or even before it has done any appreciable damage, more preventive corrosion mitigation practices may be employed. With more accurate and less expensive means of determining the extent of corrosion, it would be easier to convince management of the advisability of taking corrective or preventive measures before actual failures and great damage has occurred.

My fifth and final suggestion for gaining greater acceptance of corrosion mitigation by management is through a wide educational or publicity program on the tendency of metals to corrode and the need for mitigation. Articles in the trade journals are helpful along these lines, as are exhibits at technical society meetings, at semitechnical meetings, or at any other appropriate gathering where representatives of management may be present.

Maybe Asphalt Is the Answer

. . . now competitive with older coating

by H. C. McAninch

RECENT developments in adapting asphalt to protective coatings, particularly in cold-applied forms, have made it competitive with the older coatings. However, it is well to remember that asphalt must be applied where it will not be attacked by oils, where there is no great fire hazard, and where the maximum operating temperature of the particular coating is not exceeded.

The asphalt used and proved in ancient times was a natural product, produced by natural loss of the lighter oils from petroleum, and found exuding from springs or collected in pools and lakes. Well-known deposits of such natural asphalt are found in Trinidad Lake and in the La Brea tar pits in California.

Modern petroleum asphalt is essentially the same as the natural product, but free from mineral matter, dirt and other contamination, and refined and processed so as to have the properties required for its particular use.

Four of the properties of asphalt are of special significance in a protective coating material: (1) Resistance to attack by chemicals, (2) low permeability to water and air, (3) resistance to flow of electrical current, and (4) good adhesiveness.

Limiting its range of application is the fact that asphalt may be liquefied by dissolving it in petroleum distillates or oils. Although some types of asphalt coatings are formulated so as to be attacked only slowly by oily materials and so may not be seriously damaged by occasional brief contact with quick-evaporating oils such as gasoline, asphalts are generally not recommended for use where any type of oil or grease may come in contact with the coating.

Asphalt may be liquified by heat. As the material is warmed, it gradually softens. The hardness at any particular temperature depends upon the type of asphalt, that is, the kind and degree of processing by which it has been prepared, and also upon the presence and type of reinforcing fibres and fillers which may be present in the formulation. For any asphaltic coating there are maximum temperature conditions above which the coating may soften and become damaged.

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How to classify . . . Classified by the state of the asphalt, asphalt coatings may be hot-melt enamels, solvent cutbacks, and emulsions or dispersions. Either type of coating may be manufactured to have application consistency of a water-thin paint or of a heavy mastic, or intermediate between these two extremes. The heavier consistencies are commonly obtained by reinforcing the asphaltic material with mineral in the form of fibers or powder, or both.

Mineral fillers of either type will increase the toughness of the coating and give it more body, so that it is less likely to sag, flow, or deform at the temperatures of use. Mineral fibers such as asbestos also bridge across cracks and joints in the protected surface, and by increasing the tensile strength of the coating reduce the possibility of it being ruptured.

Hot-melt asphalt enamels consist principally of a hard grade of asphalt, frequently reinforced with mineral filler.

A coating of normal asphalt enamel requires no drying or curing. Immediately after application and inspection, an article coated with the enamel can be moved to storage or put into service.

Cutback asphalt coatings are made by dissolving a selected grade of asphalt in a volatile solvent, with or without the addition of powdered or fibrous mineral fillers. After the coating is applied, the solvent evaporates and leaves the asphalt or combination of asphalt and fillers to protect the surface.

The curing rate of a cutback coating

depends on the volatility of the solvent used. A solvent similar to gasoline in volatility will evaporate relatively fast, while one in the kerosene range is somewhat slower to dry.

In some locations the use of quick drying cutback coatings is not permitted, due to the inflammability of the light solvent. Open flames should be avoided even with the slower drying cutbacks. Not only is there fire hazard from the vapors which rise from the open container and from the fresh coating, but a small amount of the solvent may remain in the coating for a considerable time after the application is made, rendering the coating itself inflammable.

No heat to apply . . . The principal advantage of cutback asphalt coatings is that no heat is required for their application, and that they can be applied with readily available equipment. Application may be by brush, mop, spray, trowel or spreader. Another advantage is that a cutback coating is not damaged by contact with moisture immediately after application, since both the asphalt and the solvent will not mix with water.

Since curing will be retarded, cutback coatings should not be applied when the atmospheric temperature is below 40° to 45° F. or the humidity above 85 per cent, or when the surface to be coated is below the recommended temperature or at or below the dew point.

Both the asphalt and the solvent in cutback coatings thin out when warmed and become thicker when cooled. Consequently, a cutback material is more readily applied if it is at normal temperature, say between 65° and 85° F. If the container has been standing in the hot summer sun the material may be too thin to apply to proper thickness without sagging or flowing. If stored in a cold location, it may be too thick to apply easily.

Coatings consisting only of asphalt and solvent, being relatively thin in consistency, are suitable for use in relatively thin films only. In order to obtain the additional protection against corrosion and mechanical damage which would be given by a thicker coating, mineral fibers and mineral powder may be added to the cutback to produce a heavier consistency.

The asphalt solution in which the mineral fillers are suspended retains enough mobility to wet the surface to which it is applied, and to provide good adhesion, while the heavier body of the compound and the felting together of the fibers allow thicker application

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"The principal advantage of cutback asphalt coatings is that no heat is required for their application, and that they can be applied with readily available equipment."

without the coating dripping, sagging or slipping from the surface.

Due to the presence of the solvent in the composition, it is often possible to incorporate a higher ratio of filler to asphalt in a cutback composition than in a solvent-free composition for hot application. For this reason, a filled cutback composition, after it is applied and all solvent is evaporated, may withstand higher temperatures in service than a hot-melt enamel made with the same asphalt.

Emulsions and dispersions . . . Asphalt may be prepared in liquid form without use of inflammable solvents, by dispersing minute particles of the asphalt in water or other liquid in which the asphalt is not normally soluble. When the liquid vehicle evaporates, the asphalt particles fuse together leaving an intact, dry coating. Dispersions in which the vehicle is principally water are known as emulsions.

A primary advantage of these compounds is that the asphalt composition so produced can be made non-inflammable, non-toxic and practically free from odor. Another advantage is that dispersed coatings can be applied to damp surfaces without detriment to the final adhesion, whereas the surface must be completely dry for application of a cutback asphalt.

It has been found that emulsified and dispersed coatings can be compounded so that curing takes place from the inside. That is, as liquid evaporates from the surface, a wicking action draws up more liquid from below, finally pulling all the moisture away from the coated surface and evaporating it before the outside of the coating itself is finally cured.

Particularly in the case of a water emulsion of asphalt, drying is relatively slow. As long as water is present in the coating, the coating is subject to damage from contact with water. Consequently, it is necessary to protect an emulsion-based coating against rain, steam condensation or other moisture, until curing is well advanced, sometimes for several days.

As is true with cutbacks, emulsions cure more rapidly and thoroughly if temperatures are relatively high and humidity low, and they should never be applied to a cold surface on which excessive moisture may condense from the air.

By variation of the vehicle in which the asphalt is dispersed, it has been found possible to prepare dispersions which have the advantage of emulsions but dry more rapidly. It is also possible to incorporate ingredients which give improved adhesion and flexibility to the coating.

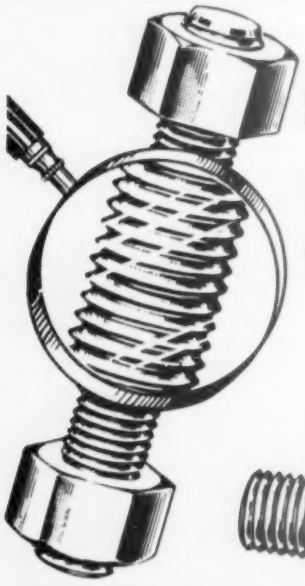
Good visosity . . . Emulsified or dispersed asphalts are less affected than cutbacks by change in temperature. In many cases the consistency changes so little between 45° and 120° F. that satisfactory application may be accomplished over this entire range of temperatures. It should be observed, however, that the air temperature should be at least 40° or 45° F., regardless of the temperature of the coating material.

By use of mineral fillers and fibers, dispersed and emulsified asphalts can be varied in consistency from liquids to heavy mastics, and may be suitable for brush, spray, mop or trowel application.

Hot-applied asphalt enamel is generally preceded by priming with a thin cutback asphalt.

Primers are frequently, but not always specified for use under cold-applied asphalt coatings. On surfaces from which it has not been possible to remove all rust, a slow-drying primer containing a drying type of oil such as linseed oil has proven satisfactory. On clean surfaces, red lead and chromate primers have been used with good results. The newer wash coat primers have also been tested under cold-applied asphalt coatings, giving good results.

Where facilities permit, spray application even of the heavier types of coating materials gives the advantages of greater speed and ease of application, and more uniformity of coating. In order to realize fully the advantage of spray application, several factors must be considered. Only a coating material especially formulated for spray application can be applied satisfactorily with spray equipment. A sprayable type material is compounded so as to flow freely under pressure through the equipment and through the material hose, and contains no coarse particles to clog the pump or spray head.



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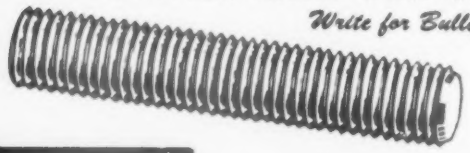

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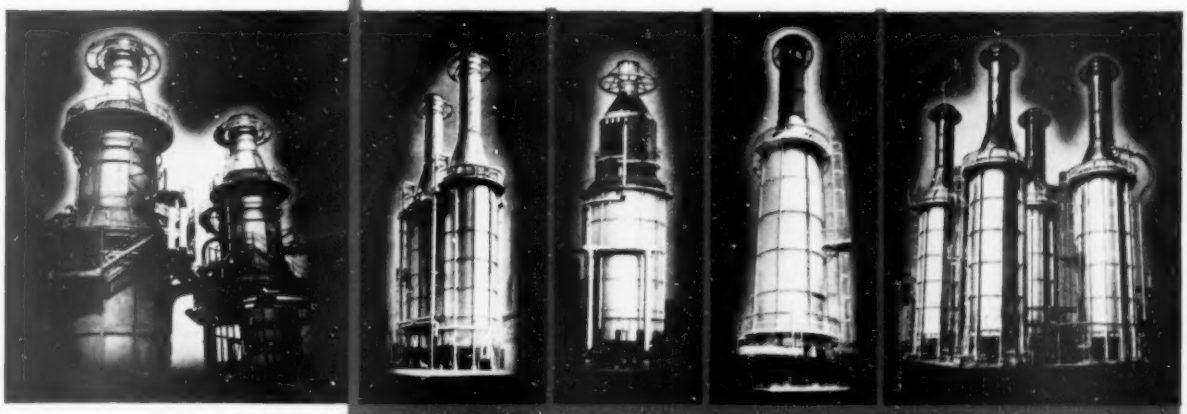

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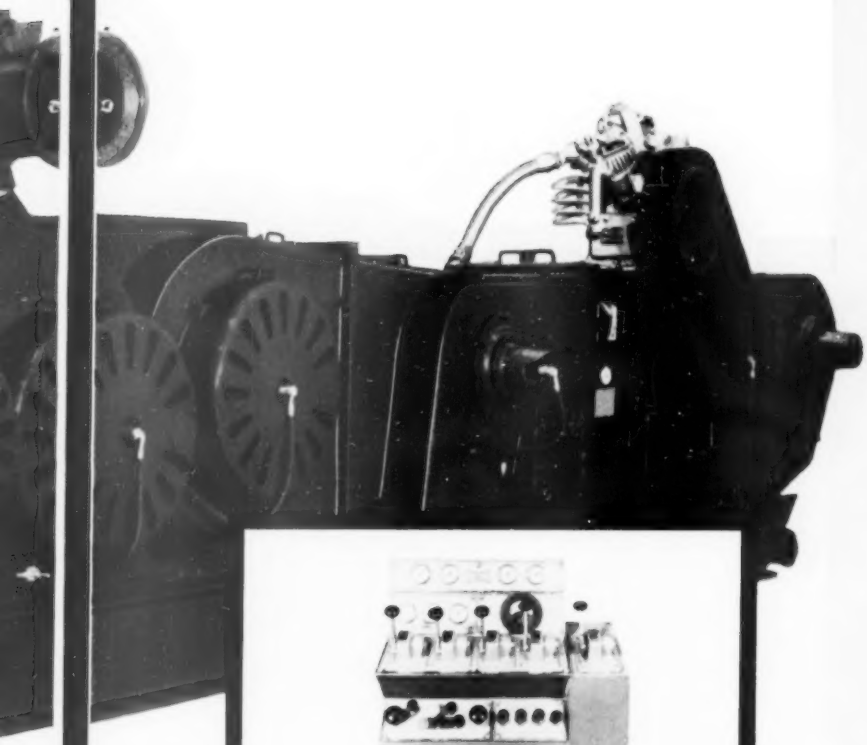

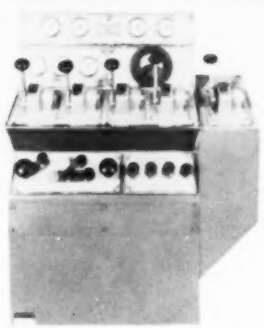

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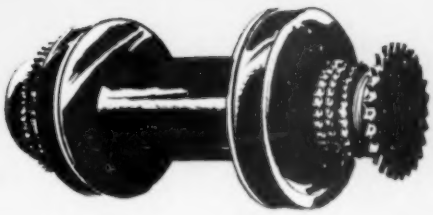

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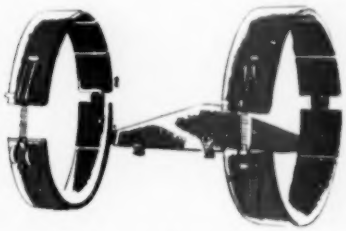

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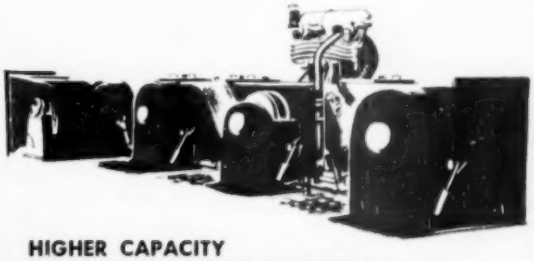

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COMBATING CORROSION . . .

How to Sell Top Management On Corrosion Mitigation

by Ted L. Canfield

HAVING been exposed to information by word of mouth, presented papers, and published articles, it is extremely doubtful that any management has not evinced some degree of interest in corrosion control with respect to its own company. So normally, the question which arises is, "to what degree does management wish to enter into this type of expenditure." Here a golden opportunity presents itself for the corrosion engineer to sell the initial stage of his program. At this time he can present data which make very impressive selling points:

1. Leak-incident-rate curves.
2. Cost-per-repaired-leakage curves
3. Cost-of-property-damage curves.
4. Cost-of-lost commodity curves.
5. Cost-of-public-hazard curves.
6. Replacement-costs curves.
7. Reconditioning-cost curves.

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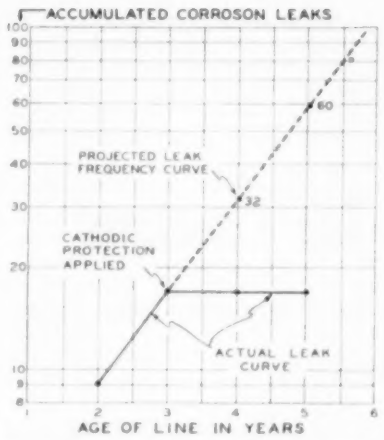


Fig. 1—On the 10-in. coated line represented by this curve, each leak was estimated to cost $1,000. The economics of adding cathodic protection then become apparent.

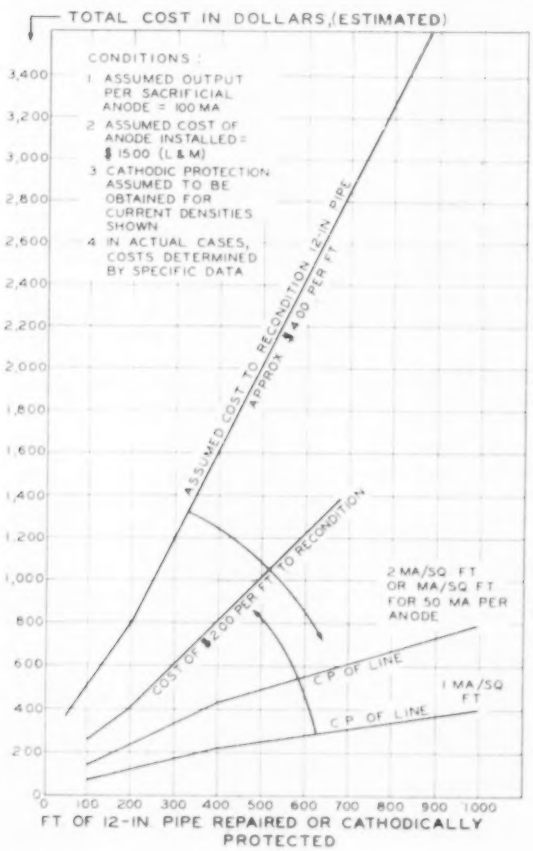

TOTAL COST IN DOLLARS,(ESTIMATED)
CONDITIONS :
1. ASSUMED OUTPUT PER SACRIFICIAL ANODE = 100 MA
2. ASSUMED COST OF ANODE INSTALLED = $ 1500 (L & M)
3. CATHODIC PROTECTION ASSUMED TO BE OBTAINED FOR CURRENT DENSITIES SHOWN
4. IN ACTUAL CASES, COSTS DETERMINED BY SPECIFIC DATA
ASSUMED COST TO RECONDITION 12-IN PIPE APPROX $ 4.00 PER FT
COST OF $ 2.00 PER FT TO RECONDITION
2 MA/SQ FT OR MA/SQ FT FOR 50 MA PER ANODE
C.P. OF LINE
1 MA/SQ FT
C.P. OF LINE
FT OF 12-IN. PIPE REPAIRED OR CATHODICALLY PROTECTED

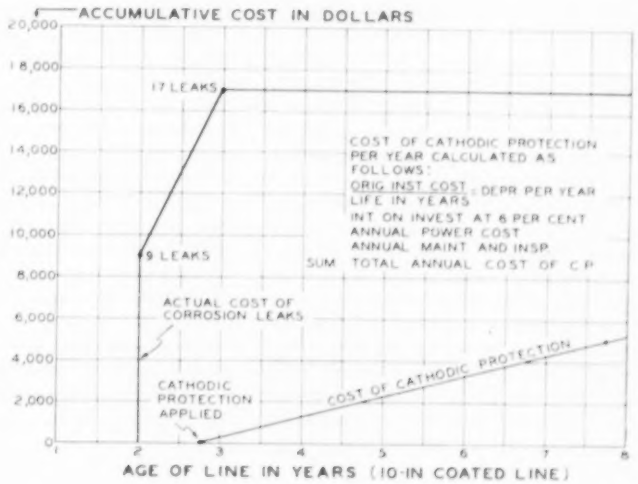
Fig. 2 (left)—This type of graph is used to show the trend of reconditioning costs against cathodic protection costs. These curves are a 12-in. bare or very poorly coated pipe.

Fig. 3 (below)—For a 24-mile section of 10-in. coated line, it is found that the interest of the $17,000 repair costs at 6 per cent is equal to the annual cost of cathodic protection.

By comparing the cost of future replacement, reconditioning, leakage, etc. against the cost of cathodic protection over a period of years, a very impressive savings in dollars and cents is apparent. Management isn't concerned about the details or complications, but most of them do appreciate having a general idea of what the term cathodic protection means. Management must, of necessity, make its decisions on the basis of investment economy, and in most cases prefers to more or less ease into a program of this nature which, even on a small scale, will involve quite an expenditure.

A very important point that is vital to the success of any good corrosion-control program is that "middle management" and field crews must be sold as completely and thoroughly as top management. The reasons are simple. First, the success of the program depends directly on the results and most of these results will not be too apparent for a period of 1 to 2 years—but they had better be very apparent by then and continue to be apparent over the period of design life. So it is of prime importance that the men on the job, the men actually doing the physical end of it, believe in the importance of the work to the point that they exert the utmost care in doing their portion of the job.

What is actually involved is a multi-phase selling project—that is, top management must be sold on economics; middle management on technique, application, and economics to a degree; and field crews primarily on application. A good opinion of your work on the part of the old pipe liners will be an excellent selling point to top management for the continuation and over-


ACCUMULATIVE COST IN DOLLARS
17 LEAKS
9 LEAKS
COST OF CATHODIC PROTECTION PER YEAR CALCULATED AS FOLLOWS:
ORIG INST COST ÷ DEPR PER YEAR
LIFE IN YEARS
INT ON INVEST AT 6 PER CENT
ANNUAL POWER COST
ANNUAL MAINT AND INSP.
SUM TOTAL ANNUAL COST OF C.P.
ACTUAL COST OF CORROSION LEAKS
CATHODIC PROTECTION APPLIED
COST OF CATHODIC PROTECTION
AGE OF LINE IN YEARS (10-IN COATED LINE)

all expansion of the program. The opinion of these men carries weight with top management, especially from the practical viewpoint.

Management expects more from the corrosion engineer than a basic knowledge of corrosion mechanisms and protective measures. It goes without saying that management will expect various records and data, accurate and in order, available at any particular time.

The corrosion engineer must learn to take into consideration several approaches to a job. Will it be better to capitalize this job or design an installation charged to maintenance? How will this installation affect the ad valorem tax situation? Is this particular procedure going to bring undue strain on the accounting routine of the company? What are the proposed operating plans for this section of line for the present and the future?

When he hears a good suggestion, or idea, he must be eager to accept it, and apply to it with the same zeal as if it were his own. He must be willing to change his plans ungrudgingly if it will benefit over-all operation.

(Graphs presented by D. B. Good, "Economic Factors, Bearing on Application of Cathodic Protection," N.A.C.E., Cathodic Protection Symposium.)

Cold-Applied Coal-Tar Coatings

. . . when and how to use them

by W. F. Fair, Jr.

THE cold-applied coal-tar-base protective coatings may be separated into the following classes:

1. A relatively fluid pitch-solvent cutback, intended for light-to-moderate corrosive environments, providing high coverage at a rate of approximately 400 sq. ft. per gallon per coat.

2. A filled, more-viscous-solvent cutback type, suitable for heavier application and more severe environments, usually applied at a rate of 100-150 sq. ft. per gallon per coat. Care should be exercised to make sure that a nonsettling product is procured, when this type is under consideration.

3. A filled heavy-duty, high-consistency thixotropic solvent cutback intended for extremely severe corrosion environments, applicable at a rate of approximately 55-70 sq. ft. per gallon per coat.

4. A high-consistency, thixotropic, filled aqueous dispersion of coal-tar pitch, intended for heavy application at a rate of about 50 sq. ft. per gallon per coat, particularly suitable for extremely corrosive atmospheres.

5. Another type required by many consumers is a cold-applied coal-tar coating which can be used in water lines, water tanks, air-conditioning ducts and the like, to protect the metal surfaces without imparting taste or odor to potable water or interior atmospheres. This fluid coating made with selected pitches and special solvents to meet the above requirements, may be applied at a rate of approximately 400 sq. ft. per gallon per coat.

Generally speaking, all the above coatings should be applied in at least two coats; sometimes a third coat is specified for particularly damaging environments.

All are self-priming . . . The above-listed coal-tar coatings are self-priming; and the manufacturers usually recommend that these types of coatings be applied to the clean bare metal directly, immediately after cleaning. Not only are general primers not needed to effect good adhesion of the dried film to the metal surface, but in many instances they may cause poor adhesion and rapid failure of the coating system.

The solvents necessarily used to dissolve or disperse coal-tar residuals in making these coatings have to be of a highly aromatic, high-solvency type. When coatings containing such solvents are applied in thicknesses such as mentioned above, which in the case of the heavy-duty, high-consistency materials will provide films of the order of 20 mils per coat, the solvents evaporate very slowly from such thick films, and hence contact any previously applied dry primer for considerable lengths of time.

Manufacturers of conventional paints, have not been able to develop a nonbituminous primer safe from attack by these solvents with this exception.

The more fluid coal-tar-solvent cutbacks are applied at high rates of coverage, and hence have relatively thin films, hardly more than the thicknesses usually obtained with conventional paints. These may be used with previously tried and selected nonbituminous primers such as red-lead primers having vehicles which are formulated to be high in resins and low in oil.

Another exception may be found in the use of coal-tar emulsions or dispersions over certain nonbituminous primers. If an inhibitory pigmented primer is desired, it should be tested in combination with the particular emulsion under consideration; it is quite likely that the emulsion, which should contain no high-solvency solvent, will adhere to the primed surface without undesirable softening of the film left by the primer.

Wash primer safe . . . One type of nonbituminous primer—which should be more appropriately described as part of the metal-conditioning system, rather than as a primer—may safely be used with cold-applied coal-tar top coats, namely wash primer.

The attempt[1] to produce a coating that would serve both as an inhibitive wash coat and a temporary anticorrosive primer resulted in a product generally known as wash primer. This wash primer is an alcohol solution of polyvinyl butyral resin, pigmented with insoluble zinc chromate, with phosphoric acid being added before primer application. Formerly the phosphoric acid was added at the time of application, but now it is understood that the final complete preparation can be packaged at the time of manufacture, although some applicators have reported difficulties with the one-package system.

Wash primer dries very quickly and may even be applied to clean, moist metal surfaces. Best results have been obtained, it is reported, when vinyl systems are used over the wash primer, but increased protection is also claimed when the wash primer is used under phenolic, alkyd, nitrocellulose, or oil-type varnishes. The wash primer is also of value in preventing undercutting and spread of corrosion, if the coating is accidentally damaged.[2]

Coal-tar coatings may be applied over wash primer, which is usually specified if for any reason the selected coating cannot be applied quickly enough to the cleaned surface, or if the surface can be cleaned but not satisfactorily dried. It should be noted that wash primer does not replace the primer of nonbituminous paint systems.

New pigmented primer . . . Recently another type of inhibitory pigmented

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primer which may have possibilities for use in combination with coal-tar top coatings has been under consideration. These are the epoxy formulations which appear to be far more resistant to the high-solvency cutbacks than are the phenolics, alkyds, and vinyls previously tested.

To make use of the resin formation to provide a primer film, the epoxy vehicle is mixed with an amine catalyst just prior to application. The catalyst increases the speed of polymerization, resulting in formation of the desired hard resinous film. Although it may be premature to describe test work on these primers, it may be stated that encouraging results are being observed but that we think it is wise at this time to adopt a conservative attitude until longer weathering results are available. Our own experimental work indicates that:

1. Development work in this field is incomplete.
2. Not all epoxy formulations will give the same desired performance.
3. Surface preparation will undoubtedly affect the net results.
4. Mixing of catalyst and coating must be done properly.
5. Prevailing temperatures have a great influence on the catalytic action and final properties of the applied coating.

It may also be stated that of the many formulations tried in combination with heavy-duty, heavily applied coal-tar coatings, certain epoxy resin formulations give promise of satisfactory compatibility with coal-tar products. However, in the past other types of nonbituminous formulations have shown promise in the laboratory and in initial field tests, but have later proved to be unsafe for use with certain top coatings, particularly the kind mentioned above.

Therefore, it is only wise to be conservative in specifying or recommending epoxy resin primers indiscriminately with any kind of bituminous top coats. Consumers interested in this type of protective system should be advised that such combinations may still be considered to be on an experimental scale. They should particularly be advised to contact the manufacturer of the bituminous coating in mind to get recommendations on the compatibility of the coating with epoxy resin primers in general, and with any specific ones that the coal-tar coating manufacturer recommends for joint use with the coal-tar top coating.

With vinyl systems . . . It was reported recently that the epoxy primer may give improved performance for vinyl systems, where it is difficult to produce conditions necessary for proper application of the vinyl primer. It was claimed that the vinyl system over the epoxy primer gave better results than a complete epoxy system.

The possibility of using epoxy primers with tar-base top coatings offers an interesting field for future investigation and evaluation.

When a shop coat is desired to protect structural members during shipment and storage, prior to field coating, the advice of the coating manufacturer on the kind of coal-tar-base shop coat recommended should be carefully followed.

It should also be noted that many of these bituminous coatings tend to alligator upon exposure to intense sunlight and attendant black-body temperature rise. It has been found that pitch emulsions not only do not alligator when applied alone in two or more coats, but also provide nonalligatoring protection, when applied over the heavy-duty thixotrophic cold coatings, or even over hot-applied coal-tar enamels, either of which dual systems offers the best in long-lasting protective combinations for the most severe atmospheric corrosion environments.

In connection with cathodic protection for underground or underwater installations, recent experimental data, subject to confirmation, indicate that the best results should be obtained by maintaining an applied potential approximately 800 mv. negative to calomel half cell.

Another type of coating having a rather unusual application is in the field of protection of creosoted railroad ties. Several railroads have found that properly pressure-treated ties will last for many years as far as rot or fungus attack are concerned. However, the ties tend to fail from mechanical cracking and subsequent entrance of water, alternate drying and wetting, and possible freezing, which enlarges the cracks in the tie.

A heavy-duty coal-tar-base coating, especially formulated to be fire retardant, over which small aggregate is cast, literally puts a weather-resistant roof on the tie, and from evidence now available definitely adds years of service life to the creosoted railroad tie. Possibilities of using such coatings over wood in various kinds of structure subjected to weather deterioration may be explored in the future.

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ORGANIC INHIBITORS

. . . their practical application in oil and gas producing wells

by P. D. Muir

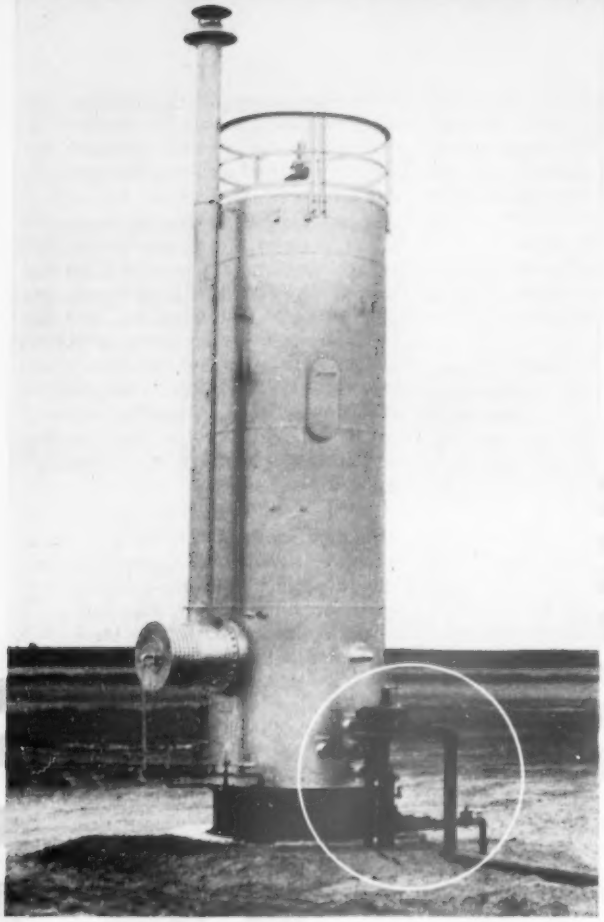
AFTER the proper organic inhibitor has been chosen to control corrosion in a well, a combination of the caliper survey, coupon test, and iron content determination should be used to insure that the inhibitor is getting to the right place to do its job.

An inhibitor must have the right chemical properties (although there may be some difference of opinion as to what these are) in order to furnish protection. However, the physical properties of inhibitors are also important. Even though an inhibitor may be chemically capable of successfully reducing corrosion, it will be of no value unless it reaches the proper point in the well. For this reason, the physical properties of inhibitors must be considered.

Author is development engineer, Dowell Incorporated, Tulsa.

In certain types of wells, an inhibitor in liquid form is the best answer to a problem. Other wells are treated more satisfactorily by the use of solid inhibitors. Recent experiments indicate that vapor phase inhibitors may find applications in oil and gas wells.

More liquid organic inhibitors are used than solids or gases. A well in which there is communication between the annular space and the tubing is best suited for normal treating procedures. The usual method is to inject the liquid inhibitors into the casing. The inhibitor then travels down the casing, around the bottom of the tubing, and is produced up through the tubing.



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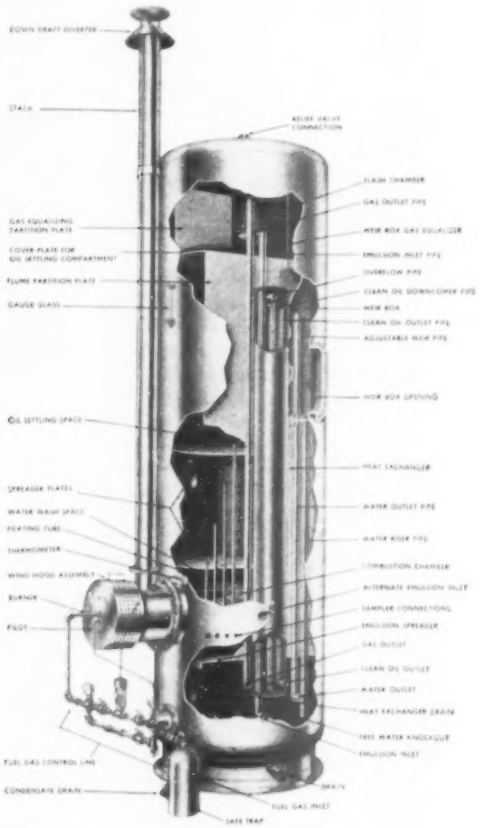

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This gives protection to both the outside and inside of the tubing, as well as the inside of the casing. As far as the use of inhibitors is concerned, this seems to be the ideal situation provided the annular space is not blocked, and the chemicals go where they are meant to go.

Pumping off . . . In a pumping well that pumps off, that is, it pumps all of the fluid that is in the well before it shuts off, there is no standing column of fluid in the annular space. Such a well may be on a pump cycle of pumping 2 hours then off 2, or some other similar cycle. During the time the pump is shut off, the fluid may rise in the annulus but by the time the pump completes its cycle, the fluid in the annular space has been removed.

Such a well is relatively simple to treat with liquids. Even though the solubility characteristics of the inhibitors, their weight, and viscosity may vary over wide ranges, they will still reach the bottom of the tubing, be pumped up through the tubing, and coat the metal surfaces inside the tubing, including the pump and rods.

In a pumping well that, for one reason or another, never quite pumps off there is always a column of fluid in the annular space. This fluid varies in height from a few feet to several hundred feet, and presents a somewhat different problem. Here the solubility characteristics and weight of the inhibitor are important.

If this fluid colmun is oil, then an oil-soluble inhibitor will simply diffuse into the oil and become highly diluted before any reaches the bottom. If, however, the inhibitor is insoluble in oil but water soluble and heavier than the oil, it will fall through the column of oil. As a result, it will be as concentrated when it reaches the bottom, as it was when it was put in.

Standing water column . . . The third case is where the standing column of fluid consists of water, on the bottom, with a layer of oil on top. Here a water-soluble material has the better chance of getting to bottom but it may be considerably diluted by the time it arrives. In such a well the heavy, water-soluble inhibitors will fall through the oil but instead of falling through the water, they will diffuse into it. After a sufficient quantity of inhibitor has been used it will finally reach the bottom.

A similar case is a well being produced by gas lift when the valves are quite a distance off bottom. Such a well is shown in Fig. 1. A column of fluid is left standing in the annulus, and in many cases this is water. Since quite often a considerable depth of water is present, a water-soluble inhibitor will become dissolved in this water and it will take quite a while before any of the inhibitor reaches bottom.

Success in treating these wells has been reported by weighting an inhibitor with glycol, thus reducing the time required for it to fall through water, and also making the inhibitor more oleophobic or oil-resistant. By being oil resistant, the inhibitor is less apt to be taken up by any oil it passes through.[1]

Protecting tubing on packer . . . Another type of well that may be treated with liquid, even though there is a packer in the well between the tubing and casing, is shown in Fig. 2. This type of well contains chemical injection valves in the tubing just above the packer, that open when a certain pressure is applied. In this type of setup, the annular space is kept full of a solution of inhibitor and oil, or inhibitor and water, at all times. Whenever it is desirable to treat the well, (this may be daily, twice weekly or even less frequently) fresh inhibitor and diluent are pumped into the casing, forcing a like amount out through the valve and into the tubing.

There is one other method used to inject liquids into a well; that is, by pumping into the tubing and shutting in the well, thus allowing the inhibitor to fall to the bottom of the tubing. A water-soluble inhibitor with a specific gravity of 1.01 has been found to fall through 40° A.P.I. oil at a rate of ¼ ft. per second. For a 10,000 ft. well this would mean leaving the well shut in for 11 hours to let the inhibitor reach bottom.

This shut-in period could be reduced by weighting the inhibitor. The shut-in period can be further reduced by pumping the inhibitor into the tubing and displacing it to bottom by pumping oil behind it. This, of course, requires a pump capable of relatively high pressures. Some companies have a truck equipped with such a pump, and this truck goes around an oil field, treating one well after another in this manner.

Thus there are three principal methods by which liquid inhibitor is injected into wells. First, by batch dumping down the casing; second, by pumping inhibitor into the tubing and either letting it fall to bottom by gravity, or displacing it to bottom by pumping oil behind it; or third, by pumping inhibitor into the casing and making use of chemical injection valves near the bottom of the tubing to allow the inhibitor to reach the inside of the tubing.

Solid sticks . . . Another form of inhibitor which may be used in wells which are packed off is a solid, usually containing the same organic inhibitors as employed in the liquid inhibitors. These inhibitors are made up into what is called a "stick" form. These sticks are lubricated into the well and allowed to sink to the bottom by gravity. The binding material in the stick, meanwhile, melts or dissolves in the well fluid, freeing the inhibitor in liquid form, in the area to be protected.

Most of the sticks currently in commercial use are made of wax-like materials, containing the organic inhibitor chemicals. In addition, they are usually weighted in some manner, in order to insure that they will fall through the fluid in the tubing. In most instances, the sticks are made with a bullet-type nose, in order to reduce the possibility of their hanging up in collars in the tubing. The size most used is about 1½ in. in diameter and about 18 in. long.

These stick-form inhibitors have been used a great deal in the Gulf Coast area

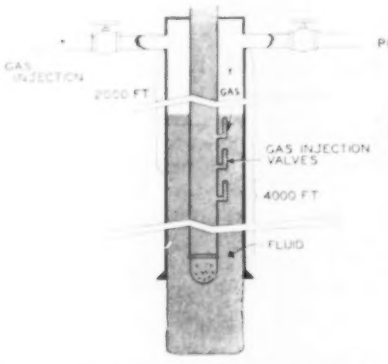

Fig. 1—The problem of getting inhibitor to the bottom of the tubing in a high-fluid-level gas-lift well like this one may be solved by weighting the inhibitor.

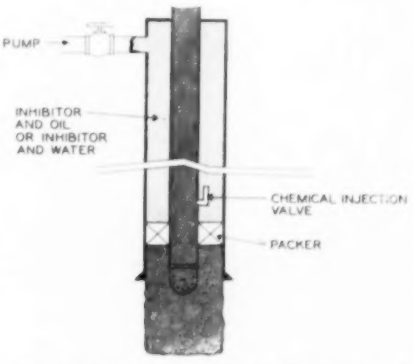

Fig. 2—When the tubing of a flowing well is set on a packer, a chemical injection valve will pass inhibitor into the lower section of the tubing.

for gas-condensate wells and also for oil wells.

Weight important . . . There are several characteristics of such a stick that are essential in order for it to perform satisfactorily. First, it must be heavy enough to fall through the fluids that are in the tubing. Second, it must dissolve or melt slowly enough in these fluids, that it will reach to the lowest point in the tubing where corrosion occurs. Third, it must be of such a size and shape that it will pass any obstructions in the upper section of the tubing. Of course, a fourth necessity is that it contain the organic inhibitors which will be carried back up the tubing in liquid form, by the well fluids, and deposited on the walls of the tubing.

Although the desired characteristics of these inhibitor sticks have been determined, not all of the problems concerned with the use of stick inhibitors have been solved. Continuing research is being conducted by both oil companies and manufacturers, to improve inhibitors from both the theoretical and practical standpoint. For example, at the present time the following improvements in stick-form inhibitors are in the process of development: (1) slower-dissolving or higher-melting-point sticks, (2) smaller-diameter sticks, (3) improved packaging of sticks, and (4) improved organic inhibitors.

The wells that are treated with sticks are flowing wells or those being produced by gas lift. The stick is dropped into the tubing and the well shut in to allow the stick to fall to bottom. The length of time required for this to occur depends on the type of well. In a gas-condensate well, the sticks will usually fall to bottom in a matter of a very few minutes. Usually the wells are shut in from 15 to 30 minutes to allow time for the stick to melt or dissolve so that it will not be produced back up the tubing.

Another procedure is to pinch down the valve in order to cut production to a rate of about 1 million cubic feet of gas a day. At this reduced rate, the stick will still fall to the bottom of the well. When using stick inhibitors in oil wells it may be necessary to shut the well in for a few hours, to insure that the stick gets all the way to the bottom.

Gaseous forms of inhibitor are also being used like the application of ammonia in protecting the casing from vapor zone corrosion[2]. Some companies are also using ammonia to protect the vapor space in storage tanks.

Fig. 3 shows a batch lubricator in which the inhibitor (either as supplied, or diluted with water or oil) is dumped into the lubricator. The valves are then opened, allowing the inhibitor to flow into the casing. It is usually flushed with the produced fluid from the well for a few minutes, to insure that it has been washed out of the lubricator and is on its way down the casing.

In cases where there is a high fluid level in the well, a considerable amount of well fluid is usually used, in an attempt to displace the inhibitor to the bottom. This type of injection is frequently used on pumping wells. It has also been used with gas-lift wells with some degree of success.

Fig. 4 shows a continuous injection system in which a small amount of inhibitor is injected with each stroke of the pump.

Checking the Protection

The most important question in the use of inhibitors is, "How do we know whether we are accomplishing our purposes in using inhibitors"? There are several methods used at the present time to check on the control of corrosion. One is by analyzing produced water for iron content, this being an indication of the amount of protection being given the well equipment.

Field testing kits have been developed that provide a rapid method of analyzing brine or condensate water for iron content. If the iron content of produced water before treatment is known, and this iron content is reduced as a result of inhibitor treatment, it is an indication that less iron is being dissolved from the well equipment.

This test is of value only if the chemical inhibitor being used does not precipitate iron. If the inhibitor will precipitate iron from solution, then the iron that is corroded from the well equipment might be put into solution and then precipitated by the inhibitor. This would result in a lower iron content at the surface even though the well might not actually be receiving any protection.

Several different methods of determining the iron content in produced water are used. Most of these methods are based on either the oxidation or reduction of iron, and all are fairly accurate. Usually the determinations are made as soon as the sample is obtained. One field kit in use is based on the oxidation of iron to its ferric state, followed by reducing it with potassium iodide. The liberated iodine is then titrated with sodium thiosulfate solution, using starch as an indicator.

Another kit determines iron colorimetrically. The water sample is treated to convert the iron present into ferric thiocyanate. The resulting characteristic color is compared to a range of standards and the iron content so determined.

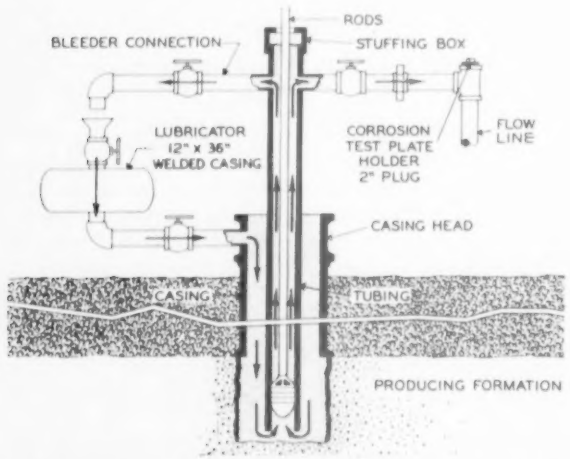

Fig. 3—Batch dumping of organic inhibitor into a well with this typical hookup simplifies corrosion control.

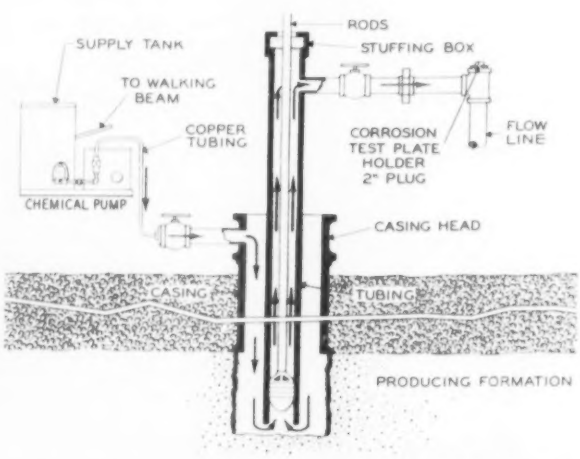

Fig. 4—A continuous system of injecting corrosion inhibitor like this injects a small amount of chemical with each stroke of the pump.

Coupon test . . . Another method used to determine the extent of protection being afforded the well is the use of metal coupons installed in the well head or flow line. These coupons are weighed before installing, then cleaned and reweighed after having been in the well for a period of time. The corrosion is then calculated from the observed weight loss, and is expressed in either inches per year penetration, or mils per year penetration.

Careful attention should be given to the installation of these coupons to make certain they are insulated from the other metal present, otherwise galvanic corrosion may occur. Comparison of the corrosion rate in the same well as indicated by the iron content and the coupon test show that the two methods are in fairly close agreement regarding the degree of protection furnished by the inhibitor to this well.

While the surface-coupon method shows the corrosion occurring at the surface of the well, it does not necessarily show the corrosion occurring in the well, due to differences in temperature, paraffin deposits, pressure, and metal characteristics. These coupons are not intended to measure the actual corrosion in the well but are used more for a comparative evaluation of the relative corrosiveness of the well.

The metal coupons are not usually made of the same grade of steel as the tubing or rods, and are not under the same conditions of stress. For these reasons they do not provide a true measure of corrosion, but they will very satisfactorily show the relation between corrosion before inhibitor treatment is begun and corrosion after inhibitors have been applied.

Down-the-hole coupons may be used which probably give a better indication of what is actually occurring in the well. These still will not reflect the true corrosion, however, due to difference in metal structure, composition and stress.

Control tests . . . Other methods used to check the amount of corrosion are to run control tests on short sections of tubing that are visually examined whenever the tubing is pulled; similarly test sucker rods are inserted in the string, and are examined whenever the rods are pulled.

One tool that is used quite extensively in checking the control of corrosion is the tubing-caliper survey, such as shown in Fig. 5, by which any pitting occurring in the tubing can be readily located. In many areas such surveys are made periodically to keep a record of subsurface corrosion. This

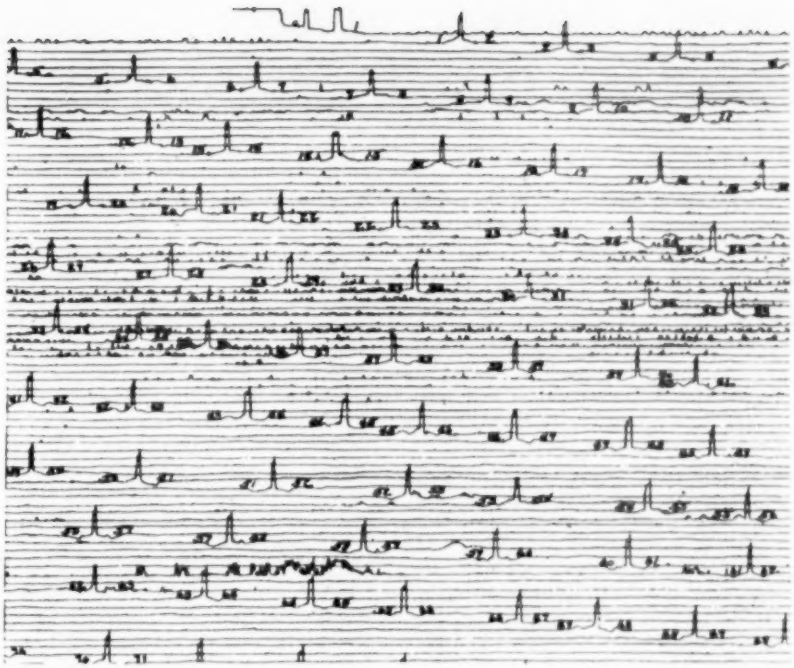

Fig. 5—One of the most widely used checks on the protection that an inhibitor gives the tubing is the caliper survey, which shows any pitting present.

is one of the best methods of determining whether protection is being obtained. The previously mentioned methods are somewhat indirect measurements, while this gives a more direct measure of the corrosion taking place, and indirectly, the protection being given the tubing.

However, even tubing-caliper surveys must be interpreted carefully, because high-pressure, sweet-oil wells often contain a considerable amount of hard calcium sulfate scale, making the tubing caliper somewhat unreliable.[3]

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Corrosion Teaching at O. U.

by John P. Roberts

FOR the most part, the personnel engaged in corrosion mitigation and research have had little or no formal instruction in or introduction to the many corrosion reactions. There are two reasons for this: (1) no corrosion course being offered at the time the individual attended college; (2) lack of student interest even if such a course was offered, especially if the course was not required as credit toward a degree. No junior engineer ever knows just what job he will be given once he leaves school and enters industry.

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The University of Oklahoma, recognizing the need for introducing this subject into its curriculum, began in the spring of 1952 to offer a course in the principles of corrosion.

The course's first 12 weeks start with a historical note, then cover successively the mechanism of film growth, corrosion by acids and alkalies, influence of environment, effect of stress, strain and structure, prevention of corrosion by soluble inhibitors and protective coverings.

The final 6-week period is devoted to practical illustration of applied principles.

COMBATING CORROSION . . .

Semipolar Organic Inhibitors Check Corrosion

. . . by forming surface films which inactivate a portion of the metal and screen it from contact with corrosion medium

by Charles M. Blair

THE results of several years' experience have clearly established that properly selected and applied semipolar organic inhibitors are capable of greatly reducing corrosion in oil wells, gas wells, pipe lines, refineries, and other petroleum-handling facilities.

The action of such inhibitors appears to result from formation of surface films which inactivate a portion of the metal and screen it from contact with the corrosion medium.

The type of corrosion encountered in typical oil and gas wells and in petroleum-processing equipment differs in several respects from that generally observed in other industries. Attack usually takes place under reducing—or at least under anaerobic—conditions; usually two, and sometimes three, or four, phases are in contact with the metal; and the corrosion products do not form thick, or highly adherent films capable of stopping the corrosion process.

Attack appears to originate from acidic constituents such as hydrogen sulfide, carbon dioxide, or organic acids in the oil, gas, or associated brine, and is abetted by high temperatures, turbulence and, to some extent, erosion and mechanical abrasion.

In 1952 a National Association of Corrosion Engineers committee made a survey of corrosion in 537 "sweet" oil wells and concluded that approximately 30 per cent of the wells in the fields surveyed showed corrosive attack.[1] This same committee also carried out a survey of corrosion in 3,052 sour-oil wells in Kansas, Texas, and Louisiana and found that approximately 80 per cent of the wells were economically affected by corrosion.

A survey of 2,466 scattered gas wells carried out by a Natural Gasoline Association of America committee in 1951 indicated that 46 per cent of these wells showed attack in the absence of preventive measures.[2] Corrosion is no respecter of geographical location, producing formation, nature of the oil, or percentage of water produced, although there is a suggestion that corrosion may tend to be somewhat greater where the water production is high.

Experience indicates that when coupons show a corrosion rate of 2 m.p.y. or more at the well-head location, serious corrosion of well equipment is to be expected. Corrosion rate surveys by the coupon technique often do not find evidence of corrosion below the surface of wells.

Also, the corrosion encountered in petroleum-handling equipment is generally characterized by pitting, so much damage may accompany very small metal losses. In many instances, damage actually resulting from corrosion is attributed to other causes. One often hears a lease operator state that he has no corrosion, but he has embrittlement and rod breakage. Embrittlement is now well recognized as being the result of penetration of the metal by atomic hydrogen resulting from corrosion. In other cases, trouble from corrosion is attributed to scale formation, sand cutting, or other causes.

Organic chemicals . . . Within recent years it has been found that certain organic chemicals or inhibitors, when added to hydrocarbon or aqueous systems in very small amounts will interfere with the corrosion process which would ordinarily take place at metallic surfaces in contact with the hydrocarbon or water.

Probably the earliest efforts at corrosion inhibition by chemicals in oil wells involved the use of inorganic alkaline reagents.

Sodium hydroxide or soda ash solutions were introduced down the casing annulus on the theory that they would neutralize acidic constituents of the oil or brine, raise the pH of the brine, and thus lessen attack. Such reagents did some good, but large quantities were required for beneficial results and the reagents frequently caused precipitation of scale in the tubing. In general, such treatment was not economically sound.

Similarly, ammonia has long been used in distillation columns of refineries to neutralize evolved acids and raise the pH of the condensate. Here again, precipitation of solid salts in vapor lines is often encountered, and corrosion is not completely eliminated, indeed, in many instances the use of ammonia has led to severe damage of cuprous alloy metals commonly used in heat exchangers.

An early use of organic inhibitors appears in the application of sodium cresylate, sodium phenolate, and similar alkali salts of weak organic acids. Results with these reagents were apparently similar to those obtained with alkalies.

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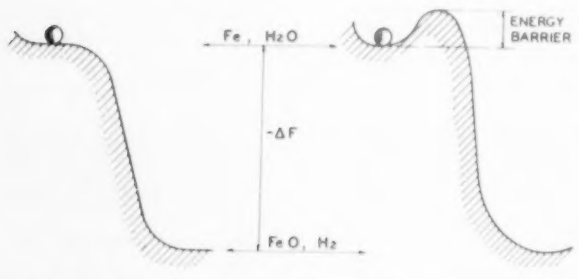

Fig. 1—Pictorial analogy for corrosion process: left, without, and right, with a potential energy barrier.

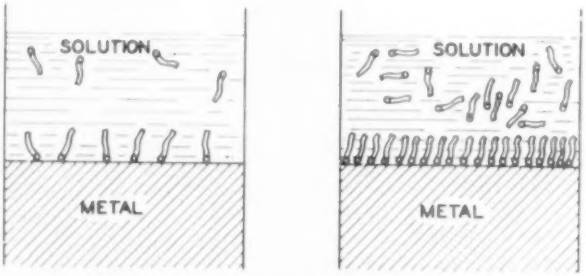

Fig. 2—Adsorbed organic inhibitor film on metal surface: left, incomplete film from very dilute solution; right, compact, organized film from more concentrated solution.

Formaldehyde was found to be an effective inhibitor in systems containing hydrogen sulfide and has found commercial use. Except for this simple organic molecule, development of inhibitors has led to the use of relatively complex, high-molecular-weight compounds. Reagents which have been found to be effective to at least some degree are characterized by high molecular weight and a semipolar structure involving a large hydrocarbon radical and a polar group containing elements such as oxygen, sulfur, or nitrogen.

Examples of such products which have been used or proposed for oilfield inhibitor use include naphthenic acids, bone oil, turkey red oil, crude coal-tar bases, aliphatic and cycloaliphatic amines, quaternary ammonium salts, esters of high-molal polycarboxylic acids, ester alcohols, ether alcohols, pyrrolidine derivatives, and various semipolar heterocyclic ring compounds.

Sour-gas line . . . Table 1 shows the results obtained in a sour-gas distributing system before and during treatment with an organic inhibitor.

This system handles approximately 10 M.M.c.f. of gas per day. A 25 per cent solution of organic inhibitor in kerosine was pumped continuously into the compressor discharge through a diesel injector nozzle, and steel test coupons were placed in the gas line at 1.6 and 3.6 miles from the compressor. After about 4 months of treatment, the corrosion rate at 3.6 miles had been reduced by about 99 per cent.

Table 2 presents results of inhibitor added down the casing of a water-supply well, and corrosion rates were measured by exposing steel coupons to the water stream at the supply well head, in the reserve tank, and at two input wells. The water system was closed, and received no other treatment except the addition of polyphosphate. More than a 95 per cent reduction in corrosion rate was obtained by the use of about 10 p.p.m. of inhibitor in the water.

Results obtainable in petroleum processing units are exemplified by the data from a midwestern refiner, in which the overhead product from a bubble-tower crude unit is treated with organic inhibitor. The liquid inhibitor is pumped into the overhead vapor line at the rate of 2 gal. per day, a concentration of 20 p.p.m. in the total overhead, including reflux. Ammonia is also injected into the tower to maintain a pH of 7 to 7.5 in the accumulator water.

Whereas the primary cooler bundle formerly required at least partial retubing after about 60 days' service, it has required no attention in 300 days since inhibitor was started. Continued experience with inhibitor in this refinery has shown a reduction of corrosion losses of treated equipment by 90 per cent or more, an elimination of fouling in the fractionator, and generally improved heat exchange.

The detergent action of the inhibitor in keeping the tower and trays clean is alone judged to save cleaning time and labor more than sufficient to justify its use. Experience in numerous refinery applications confirm such results.[3]

TABLE 1—HISTORY OF CORROSION IN SOUR-GAS DISTRIBUTING SYSTEM CORROSION INHIBITOR INTRODUCED AT COMPRESSOR DISCHARGE

Test period (1949)—	Quarts of inhibitor used per M.M.c.f. of gas	Corrosion rates (m.p.y.) 1.6 miles from compressor	Corrosion rates (m.p.y.) 3.6 miles from compressor
March 10 to March 25		28.9	31.5
April 20 to May 6	2	6.46	3.29
May 6 to May 20	2	5.18	4.90
May 20 to June 7	2	0.22	3.29
June 7 to June 22	2	0.09	0.72
June 22 to July 6	2	0.33	0.26
July 6 to July 20	2	0.54	0.25
July 20 to August 3	2	0.51	0.14
August 3 to August 31	2	0.27	0.16
August 31 to October 12	2	0.15	0.08
October 12 to November 22	2	0.34	0.15
November 22 to December 29	2	0.16	0.22

TABLE 2—HISTORY OF CORROSION IN WATER-FLOOD SYSTEM CORROSION INHIBITOR INTRODUCED DOWN CASING ANNULUS OF WATER SUPPLY WELL

Test period (1950)—	Volume ratio water-inhibitor	Corrosion rates (m.p.y.) Supply well head	Reserve tank	Input well No. 1	Input well No. 2
May 27 to June 12	(*)	18.2	13.3	9.6	10.4
June 12 to July 15	(*)	26.7	11.6	9.0	10.7
September 12 to September 26	88,200	1.1	1.8	1.0	0.79
October 11 to October 24	101,500	0.55	(†)	0.57	0.63
October 24 to November 14	101,500	0.58	(†)	0.37	0.37

*No inhibitor used. †Not determined.

Mechanism of Corrosion Inhibition

Most metals in the free, or metallic, state are at a higher energy level than that of their compounds, such as the oxides, chlorides, sulfides, etc. Therefore, the free metal will ordinarily tend to combine with many compounds encountered in its environment, rather than remain as the element. Thus, corrosion is a spontaneous process demanded by thermodynamic considerations. Iron and the ferrous metals, on which we are largely dependent in the petroleum industry, are particularly unstable with respect to reactivity with water, acids, oxygen and many other commonly encountered materials.

That ferrous (and many other) metals can be used at all hinges on the fact that the rate of reaction responsible for corrosion is often very slow and in other instances is prevented by some energy barrier in the reaction.

In the simple case of pure iron in distilled water, the metallic iron should react to form iron oxide and hydrogen with an over-all decrease in free energy. Actually, however, this does not occur at ordinary temperatures (in the absence of oxygen) due to a substantial energy barrier which appears to arise from the slow combination of hydrogen atoms, first formed in the corrosion process, to give molecular hydrogen. Oxygen, a high hydrogen ion concentration, and many other materials, when present in the system, lower or remove this energy barrier and thereby allow the spontaneous corrosion process to proceed.

Electrochemical . . . In a sense all oxidation-reduction reactions are electrochemical in that a transfer of electrons from one nucleus to another is involved. In the case of corrosion, however, it is postulated that at least two heterogeneous reactions occur at spatially separated areas on the metal surface, one being an oxidation of the metal (at the so-called anode) and one being a reduction of a constituent in the adjacent environment (at the so-called cathode), with an appropriate flow of electrons through the metal from the anode to the cathode. Since these two reactions are electrically interdependent it is theoretically possible to impede the corrosion process by introducing an energy barrier to either the anodic or cathodic reactions.

The relatively high molecular weight, semipolar inhibitors of the types used to give the results such as described above are believed to function by adsorption on metal surfaces to give well organized surface films. Whether such

films are preferentially adsorbed at particular spots on the metal surface, such as at local anodes or cathodes of a corrosion cell, has not been clearly established. Also, the nature of the forces responsible for adsorption are not clearly determined.

Film action . . . Fig. 2 shows what is now postulated as being the kind of film accounting for inhibitor action. The drawing on the left shows a few molecules of inhibitor adsorbed or attached to a metal surface through the polar end. This is supposed to represent the kind of incomplete film to be expected from a dilute solution of organic inhibitor in the fluids passing over the metal.

As in the case of other adsorption phenomena, there is probably a constant competition between the metal surface and the fluids for the inhibitor molecules. When the inhibitor concentration is increased, as indicated in the right-hand drawing, we visualize more of the metal surface being covered with inhibitor molecules, until, finally, a fairly close-packed oriented layer is formed.

It seems likely that the surface metal atoms actually covered by or attached to the adsorbed molecules are incapable of reacting with the corrosive medium. In addition, however, and probably of great importance in explaining inhibitor effectiveness, such a layer probably presents a barrier to the migration of hydrated hydrogen ions or other solutes to all of the metal surface, and thus prevents initiation of the corrosion reaction. Similarly, it would hinder the migration of ferrous or other metal ions from the surface to the solution.

It is well established that close-packed surface films are capable of introducing a large energy barrier to migration through the film of even small molecules. For example, Langmuir and Schaefer[4] studied the effect of surface films in preventing the evaporation of water and found that on migration of water molecules through oriented films, pressures in the order of 12,000 atm. must be overcome. Such high pressures apparently result from close approach of hydrocarbon groups in the adsorbed molecules making up the film and the resistance of such groups to displacement in an oriented film.

This kind of effect, combined with the actual mechanical coverage of much of the metal surface by adsorbed molecules may well account for inhibitor action.

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Microbiological Corrosion

Many theories exist on causes of this problem

by J. Bennett Clark

IT is the autotrophic organisms which have been predominately incriminated in microbiological corrosion.

Because some of the bacteria use sulfur in their energy metabolism, we can group them together as the sulfur bacteria. The more important members of this group include:

1. Thisosulfate oxidizing (Thiobacillus thioparus), which has not been incriminated in severe cases of corrosion, but well may be involved under certain conditions.

2. Sulfur oxidizing (Thiobacillus thiooxidans), which has been found responsible for the breakdown of pipeline sealing compounds which contain elemental sulfur as one ingredient.

3. Sulfate reducing (Sporovibrio desulfuricans), which is found in mud sewage, oil wells, soil, bottom deposits, and sometimes in concrete. This organism is very important in corrosion and will be discussed later.

Nitrogen bacteria . . . Many soil bacteria are noted for their transformations of inorganic nitrogen compounds. These include the nitrifying bacteria; and they may be involved in rare cases of corrosion, particularly in the breakdown of sealing compounds.

Iron bacteria . . . Some soil microorganisms obtain energy from the oxidation of ferrous salts to ferric salts. These organisms are usually considered as fouling organisms rather than as corrosion organisms, but they may be involved in anodic corrosion.

Not severely corrosive . . . The chemical activity of microscopic forms of life as they are normally distributed in a soil cannot explain severe cases of corrosion. The specific organisms exist in too few numbers and are too uniformly distributed to be of major significance.

However, if some factor in the soil can cause a concentration of certain types of microorganisms, severe damage to metallic objects could easily result.

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The best-understood case of such concentration occurs with the sulfate-reducing bacteria. These organisms, are autotrophic and obtain their energy from the oxidation of hydrogen, and thus they will concentrate in the selective environment created at the sites on pipe lines at which polarizing hydrogen is released. The bacteria remove this cathodic hydrogen by oxidation and as a result the galvanic reaction in which the hydrogen is formed can proceed at a rapid rate.

In addition to furthering the galvanic reaction, these bacteria also produce sulfides which have additional detrimental effects on the pipe. This type of corrosion is found only under anaerobic conditions in which the oxidation-reduction potential of the soil is less than —200 mv.; however, it is one of the most significant types of biological corrosion.

The above mechanism has been used to explain many cases of corrosion in which it probably does not apply. In many cases the factors involved at the corrosion site are not ideal for the growth of the sulfate reducers, and in many such cases it is probable that some other mechanism is involved.

Bacteria active . . . On the basis of some cases he has studied, Kulman[1] postulates that bacteria are active in forming differential oxidation cells. The wide variety of heterotrophic organisms found in the soil feed on organic matter near the pipe surface, and as a result of their activity deplete the oxygen content at localized areas in the soil, thus inducing localized anaerobiosis.

During growth of these organisms the oxide film on the buried pipe is removed in localized areas, causing these areas to become anodic with respect to adjacent pipe areas in more aerated soils. This sets up a galvanic cell which may have a potential of 0.2 to 0.3 volt. The sulfate reducers can become active at the site of polarizing hydrogen produced by this galvanic cell when the oxygen is depleted or the

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EXAMPLE: Except for a small trace of oil, this well appeared to be dry. However, the McCullough Radiation Well Logger with Scintillometer picked up a four foot stringer of porous limestone at 3013 feet, confined above and below by shale beds. This four foot zone was perforated with 16 holes by a McCullough Standard Casing Glass Jet Perforator. Production — 150 barrels of oil per day from what otherwise might have been a dry hole. Time on the job — only six hours to log and perforate.

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soil oxidation - reduction potential is lowered below —200 mv.

It is also possible that microbial decomposition products from a wide variety of organisms can be deposited on metal surfaces in the soil. If the film is imperfect, bare areas may become corroded due to the galvanic potential between the metal and the deposited film. For example, iron is anodic to FeS which could be formed microbiologically.

Recently Kühr and Van der Vlugt[2] have presented a study of certain cases of corrosion and have concluded that under appropriate conditions, the iron bacteria collect at anodic areas in water pipes while the sulfate-reducing bacteria collect at cathodic areas. This affords another good example of the present trend to explain biological corrosion in terms of multiple factors rather than to lay all the blame on one particular type of bacterial cell.

Work together . . . It is significant to the over-all understanding of the function of biological factors in corrosion, that more workers are thinking in terms of microbial populations rather than in terms of single species. It is probable that multiple factors, physical, chemical, and perhaps biological, are involved in most cases of corrosion. Many of the transformations that occur in the soil are essentially the result of the cooperation of many types of microorganisms.

The ubiquity and variability of microorganisms present another problem in corrosion. It has been found that specific organisms exist that can utilize ingredients of protective coatings as food materials. The case of the sulfur-oxidizing bacteria breaking down pipe-seal compounds has already been stated.

It is possible for some organisms to even destroy plastics, either by utilizing them as food materials or by excreting destructive compounds on the plastic.

Cathodic protection has been very effective in preventing corrosion from the activity of the bacteria that utilize polarizing hydrogen and thus concentrate at cathodic areas. Protective coatings have been relatively satisfactory in that if properly applied they can at least greatly prolong pipe life by delaying corrosive processes.

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Impressed Current Provides Good Cathodic Protection for Pipe Lines

by B. J. Whitley, Jr.

BECAUSE soils differ chemically and electrically, there are low-resistance soils that are good conductors of electricity, good electrolytes, and that have negative polarity to the more positive high-resistance soils. However, conditions are stable until someone lays a pipe line through these soils and "shorts them out." If the line could have a perfect coating job, all would be fine but there is no such a thing, and the current flows through the holidays in the coating and on to the pipe.

Corrosion occurs where this current leaves the pipe to complete the circuit. Without protection, the path of the electric current is through the pipe toward the more negative voltage (anodic area), off the pipe at the negative soil, through the earth, and back to the pipe (cathodic area) at the more positive soil.

Corrosion takes place at the anodic negative area as the electric current detaches positive metal atoms from the surface and they enter the negative soil as positively charged ions. If all the pipe could be made cathodic, or receiver of current, instead of anodic, emitter, then the corrosion would stop. That is done in cathodic protection.

The electric current is drawn off the pipe and out into the earth through a ground bed as emitter, thus corroding it and not the pipe. A sufficient amount of current is forced out through the ground bed back to the pipe to maintain an adequate supply of electrons on the pipe surface to supply all the positive hydrogen ions, maintaining the necessary potential on the pipe. It is generally agreed that a potential of minus 0.85 volts to a copper sulfate reference electrode indicates a sufficient current density to afford protection.

Coating resistance . . . Everyone agrees corrosion control starts in the design of the pipe-line system, but usually the task is to protect the structure after it has been placed in service. Consequently, it becomes necessary to determine the condition of the coating by a coating-resistance test, and it could be expressed numerically in ohms per square unit of area or some other standard.

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The decision will have to be made whether to use spot protection of anodic areas, usually located by earth current and surface potential surveys, or to protect the entire line. If the line is relatively new, with a fair coating, it will be cheaper to protect the entire line than to spend a lot of money to locate the anodic areas.

The current required to cathodically protect an underground structure from corrosion can be approximated by deciding on a recommended current density, and then the design of the ground beds, and rectifier ratings can be made to fit. But this is a big gamble, especially on coated surfaces where the condition of the coating and the current requirements cannot be approximated. On bare surfaces, the distribution of the current cannot be anticipated.

The procedure recommended is to make a current - requirement survey, then the ground beds can be designed with assurance. Actual field current-requirement tests reveal the noninsulated casings, bare spots, foreign contacts and items not strictly holidays. The rectifiers can be purchased with the known required current output and voltage to match the ground bed resistances.

Temporary ground bed . . . The technique is to install some sort of a temporary ground bed and use a portable source of power, welding machine, batteries, or small rectifiers. The temporary ground beds used in the past have varied from several reinforcing rods driven into the ground, buried plate steel or pipe, and even steel highway guard rails around curves in the road. However, common household aluminum foil, unrolled into water or wet down on the earth, provides a highly satisfactory ground bed.

When the current is applied, at several magnitudes if desired, using these temporary ground beds, the pipe-to-soil voltage can be noted to determine the extent of the protection being received from each known current output. The pipe-to-soil voltage should also be noted with no current to be certain that the observed potential is the result of the

applied current. The amount of current required to give the desired protection can be noted from this survey.

Surface-potential readings give a good indication also of the current applied to bare pipe. In this observation, the voltage is noted between two half cells or pins spaced about 25 ft. along the right-of-way over the line to get a polarity and magnitude indication of the current flowing in the line.

Ground bed locations . . . Now that the amount of current needed is known, the site for a permanent ground bed can be selected. Several factors can help make this selection:

1. The bed should be located in the lowest-resistivity soil found.

2. Power must be available.

3. It should be located so that maintenance would be easy and rectifier readings could be taken conveniently.

4. The site should be in a place where you can actually get in and build it. Low-resistivity soil will occasionally be found in a spot where construction would be impossible.

5. In some areas, sites will have to be selected so that it will be easy to water the ground bed during drought periods.

6. Locate them away from all structures that might be harmed by stray currents.

7. Arrrangements will have to be made with the land owner for the easement.

8. For rectifier installations in plant yards the site will have to be picked for each separate case. It seems more advantageous though to locate them close to the available power source.

Designing ground beds . . . Once the required current is known, and the site selected and secured, then the design of the bed can be completed. The number of the anodes and the spacing will be determined by the current output and the soil resistivity. For low currents in low-resistance soils, spacings of from 10 to 15 ft. may be tolerated. Spacing the anodes more than 35 or 40 ft. does not help much, and it is recommended that the closest anode be at least 300 to 400 ft. from the protected structure, particularly on bare pipe where concentrated beds are used.

In the case of the bare pipe, there is considerable merit in distributing the anodes along the line rather than in the concentrated beds. This technique results in a more even current density, and is receiving more attention by engineers.

Keep bed resistance low . . . The power bill will be less, of course, if the bed resistance is kept as low as possible. There isn't much that can be done about the soil resistivity, but a lower bed resistance can be obtained by using more anodes with greater spacing.

The number of anodes will also be determined by the desired current output. The anode manufacturers recommend for the 3 by 60-in. graphite anode a current output of 4 amp. in salt water or in a prepared backfill, and 1 amp. in fresh water or without a backfill. When steel is used for anodes, allow from 20 to 25 lb. per ampere per year, assuming uniform current density.

The size of the positive header cable to connect the anodes to depends on the current, of course, and the type depends on whether it is to be buried or installed overhead. If buried, an insulation suitable for direct burial will be needed, Type RR, TW, trenchlay, etc. Splices will have to be insulated very carefully, and it would be helpful to measure their locations. If pipe-to-soil voltage readings are taken with the plug over each known anode location right after construction and recorded then the individual anode performances can be checked periodically for broken connections.

Bare cables can be used for the positive header if it is mounted aboveground on fence posts or poles.

The size of the negative lead to the pipe will also depend on the current to be carried, and it should be insulated to keep it from absorbing any protective current.

For congested plant yards, individual beds can be located around the yard. However, we find it much more effective to use a distributed bed, that is, scatter the anodes throughout the station yard. This supplies the current where it is needed most.

Junction boxes can be used at each anode to facilitate current readings and break the positive distribution lines up into short runs so that broken cables can be found easily.

Construction of bed . . . Holes for the graphite anodes should be about 10 in. in diameter and drilled so that there will be at least a foot of backfill below and above the anode. A little water added to the coke breeze as it is poured in the hole will aid in tamping the coke tight. In water-filled holes, the anodes and backfill have been sewn in sacks for installation.

The insulation of the lead connection to the anode is a source of trouble. A good seal at the time of installation is essential and the addition of some sort of rubber cement where the lead enters the anode may save a lot of work later.

A good connection by the negative lead to the pipe can be obtained by first brazing the cable to a steel coupon that can be welded to the pipe.

Steel railroad rail, pipe, or structural steel make good anodes. They may be buried in a mass and welded together; however, an effective arrangement is to place individual rails as you would graphite anodes. In this case, the top of the rail could be left aboveground several inches so the area of contact made by the lead wire will not be subjected to corrosion. Even then the bronze and bare copper should be coated where high water is possible. Salt may be mixed with the earth backfill for steel anodes to lower the contact resistance.

The rectifiers can be mounted on poles or foundations but should always be grounded for safety. The a.c. service connections should be according to electrical code; check the polarity of the rectifier output immediately after installation.

After current is on . . . When the permanent installation is placed in service the rectifier output and the extent of the applied protection should be noted periodically. If the rectifier is read and the readings recorded once a week a complete history of its operation is obtained.

The pipe-to-soil survey should be made with several things in mind:

1. The reference plug, usually a copper-sulfate half cell, is placed directly over the line.

2. A suitable high-resistance voltmeter, or a potentiometer should be used. Use the voltmeter scale giving a upscale reading.

3. A good contact to the pipe is necessary. Test leads of copper wire brazed to the line at each road will enable you to obtain a complete survey, on well coated lines.

4. When readings are to be taken at casings, drips, taps, valves, dehydration plants, or similar places, multiple readings should be noted. A local reading with the plug at the object and a reading taken about 100 ft. along the line in both directions will usually show there is bare pipe at the structure by a lower reading there.

At pipe-line crossings if considerable interference is present, it may be detected by noting pipe-to-soil voltages at the crossing and at close intervals away from the crossing for about 200 ft. The voltage on the anodic pipe will be more positive at the crossing than on either side if cathodic protection is the cause.

COMBATING CORROSION . . .

Fundamental Electrochemistry of Corrosion

"... the physics of ionic solutions and the chemistry of oxidation-reduction reactions."

by Bernard O. Heston

IN corrosion work, the reaction of interest is the one in which a metal is converted into ions, or into some compound. The corrosion-mitigation program is concerned with ways to prevent this reaction, or perhaps with some way to slow it down until the loss of metal becomes negligible.

That is where electrochemistry enters the picture, for electrochemistry is the physics of ionic solutions and the chemistry of oxidation-reduction reactions. For clarification we will define oxidation as (1) an increase in the positive valence of an atom or radical or (2) a loss of electrons by an atom radical. The opposite process, reduction, is an increase in the valence in the opposite or negative direction, or a gain in electrons.

It is sometimes very useful to break the equation for the reaction into two so-called half reactions where one-half represents the oxidation process and the other the reduction process. When this is done the oxidation will show electrons among the products, and the reduction will have an equal number of electrons among the reactants.

In many cases we can actually separate the two halves of a red-ox reaction in the laboratory. Consider a simple electrolysis of an aqueous solution of a copper salt. As the current is passed through the solutions electrons from the power supply enter at the cathode and react with copper ions, causing them to lose their charge and become copper atoms plated on the surface of the electrode. The equation for the reaction can be written as $Cu^{++} + 2e \rightarrow Cu$. At the anode the reverse reaction occurs, and copper atoms "dissolve" to form ions according to the equation $Cu \rightarrow Cu^{++} + 2e$. The net result of these two half reactions is, of course, the transfer of copper from the anode to the cathode of the electrolytic cell.

If the two half reactions are not the exact reverse of each other we can still separate them in many cells. If we electrolyze water, in an acid or alkaline solution with "inert" electrodes the reactions are $2H^+ + 2e \rightarrow H_2$ at the cathode, and $4OH^- \rightarrow O_2 + 2H_2O +$ 4e at the anode. In order to add these equations to get the complete equation for the reaction we will have to double the quantities in the first, so as not to have any free electrons showing, and we get two volumes of hydrogen produced for each volume of oxygen.

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The anode reaction . . . The reaction which converts a metal into ions or a compound is the anode reaction, or oxidation by which electrons are lost and ions are formed. It can be written very generally as $M \rightarrow M^{n+} + ne$, where n is the valence of the metal.

If we imagine that any metal, upon being placed in water, undergoes the above reaction leaving the electrons behind, we can see that a charge will accumulate on the metal. The charge will be negative because the electrons are negative, and since the ions are all positive they will be attracted toward the surface by forces strong enough to prevent them from escaping completely into the bulk of the solution. Before very many have entered the solution, many of those which have previously escaped will be attracted back to the metal surface. In a short time the number leaving will just equal the number coming back.

The potential or voltage that must exist on the electrode when it is in this equilibrium condition would presumably be a measure of the tendency of that metal to dissolve or undergo oxidation. Unfortunately, it is not possible to measure this potential, so it is agreed in electrochemistry to accept one particular electrode as a reference, and compare all others with it. The electrode chosen is the hydrogen electrode.

The hydrogen electrode is a platinized platinum plate or wire, immersed in a solution in which hydrogen ions are at the ideal one molar concentration, and which is saturated with hydrogen gas at 1 atm. pressure. The half reaction which occurs at this electrode is the same as the one previously given.

The effect of concentration on the potential of a single electrode is given by the Nernst equation, $E = E^\circ - RT/nF \ln (M^{n+})$ where again n represents the valence of the ions and where the parentheses signify concentration. F is the value of the Faraday, R is the gas constant, and T the absolute temperature. E° is the standard potential, obtained as mentioned before.

If we plot E vs. ln (M^{n+}), we obtain a straight line having a slope from which we may obtain the valence, or valence change for the reaction, and which shows higher and higher potentials as the concentration of metal ions is decreased. Thus, the tendency for the metal to dissolve increases at lower concentrations, as is to be expected, and at very low concentrations approaching zero, this tendency becomes very large indeed.

This means that if there are few ions present in solution the metal will oxidize much more rapidly, if the reaction has any way to continue, that is, if there is anything present to take up the electrons which are left behind, or if the electrons can be transported to a place where some reduction reaction is occurring.

Standard potential . . . A standard potential is the potential of a cell in which the anode reaction is being investigated, and in which the cathode is a standard hydrogen electrode. It should be understood that we are defining the anode as the electrode at which oxidation occurs, the cathode as the electrode where reduction occurs.

There are thus many half reactions which, in conjunction with the oxidation of a metal, form a complete reaction, and therefore enable the metal to form ions, or dissolve. The materials which enter a reaction in this way are often called corrosives. The reduction of the halogens, and of many more complicated ions provides a use for the electrons resulting from the oxidation of the metal, and causes the reaction to continue.

There are two ways to prevent the reactions responsible for corrosion, viz., prevent access of the metal ions to the solution, or prevent the escape of the electrons produced by the oxidation reaction.

Some of the more obvious methods for preventing the ions from going into solution are protective coatings applied

to the surface, films of oxides or other compounds which form protective coatings, keeping a high concentration of the same type of ion in the solution, or maintaining a high negative charge on the metal surface so that ions which bear a positive charge cannot escape. The second way would be to provide a source of electrons at a higher potential which will oppose the flow of electrons away from the metal surface, or to use a film to cover those parts of the surface at which electrons are most apt to react with other constituents of the solution.

The applied protective coating must prevent the solution from making contact with the metal surface, and probably needs other properties for special applications. It is an effective insulator of the surface from all solution effects.

An oxide or chemical film, which can be produced either in situ, or by some kind of pretreatment, must do essentially the same thing, but since it is often made up of a compound of the metal itself it must not only prevent the constituents of the solution from contacting the bare metal but also prevent the diffusion of metal ions through the film to the outside where they may react. It should be a good electrical insulator also, or else it will provide cathodic areas from which electrons may react with reducible ions in the solution. If both of these things can happen through the film we may find that the rate of corrosion is faster at first, and only after the film acquires sufficient thickness does the reaction become slower.

Such previous films do not completely inhibit the reactions but they may be quite effective in slowing the reaction to some acceptable rate.

High concentrations . . . The use of high metal ion concentrations is ordinarily not a practical solution. In the case of very "inert" metals it would offer no problem in most solutions. To take an example or two, consider a gold surface in a 1-molar acid solution. From the activity series we can calculate the equilibrium concentration of Au^{+++} ions, and when we do we find that the gold will not dissolve, with the evolution of hydrogen, if the concentration of the ions exceeds 1×10^{-7} moles per liter. From this it appears that gold would make an ideal noncorrosive surface, and for this particular reaction it would.

On the other hand, there are some reactions for which it is not possible to obtain a gold concentration high enough to prevent chemical attack, as for example in alkaline cyanide solutions where, because of complex ion formation, the gold ion concentration remains vanishingly small. This same situation may exist with other so-called inert metals.

The more active metals ordinarily present a more difficult case. With zinc, for example, in 1-molar acid, the ionic concentration would have to be about $1 \times 10^{+25}$ moles per liter to prevent further solution of zinc. This is about $6 \times 10^{+20}$ ions of zinc per liter, a concentration which is ridiculously large.

If we try the reaction in the laboratory using pure zinc, and say, 1-molar sulfuric acid, we find that the reaction is very slow, and apparently not much affected by the concentration of the zinc ions in the solution, and this fact alone tells us that we are dealing with some phenomenon not covered by the simple equilibrium case on which we have based the calculation. This difference we explain by noting that there is a very slow process, the transfer of electrons to the reducible ion, which tends to inhibit the reaction.

From electrochemistry we can tell when a reaction is possible, and some of the things that might be done to prevent it.

We can frequently supply electrons from another oxidation reaction, so as to make a given metal surface cathodic, rather than anodic. This can be done by using a very active sacrificial metal which will dissolve and produce electrons at a higher potential than can be obtained by the solution of the metal we wish to protect.

In some instances the electrons could even be supplied by a generator, but in either case there will need to be an oxidation of some kind occurring if any reduction takes place at this cathodic surface. The protection of iron with zinc, as is accomplished by galvanizing, is at least partially by this means.

Good Design NOW, Will Stop Corrosion LATER

by E. A. Prange

DESIGNING for corrosive services is more than selecting material with good corrosion resistance. Processes can be changed to make them less corrosive, metals can be heat treated to increase corrosion resistance, and good inspection may allow the use of less corrosion-resistant and cheaper materials.

There are three ways to control corrosion and most problems should be examined from all three viewpoints in order to arrive at the best solution. The control methods are:

1. Change the process to make it less corrosive.
2. Use more corrosion-resistant materials.
3. Put a barrier between the corrosive fluid and the load-carrying base metal.

An example of the first control method is the instance of liquid-phase butane isomerization units which experienced corrosion rates on steel up to 10 in. per year. Hastelloy B lining material was adequately corrosion resistant, but it cost a great deal and was difficult to apply to the steel vessels. An excellent solution to the problem was to change the process to a vapor-phase cycle in which steel corrodes at the rate of only a few thousandths of an inch per year.

The use of corrosion-resistant materials, much of the time in process industry work, is not nearly as applicable as the first control method. Each case must be considered on its own merits.

The third method, somewhat similar to the second, is to place a barrier between the corrosive fluid and the load-carrying base metal. Such barriers may be lead or stainless-steel linings, porcelain coatings, rubber sheet, or paint. Several difficulties are inherent in the use of these. Ordinarily it is not easy to get an acceptable bond beween the base metal and the barrier material. Neither is it easy to avoid communication between the inside of the envelope and the exterior. Pinholes, slag pockets, and cracks are common. Very thin films, such as paint film, have application only when the fluid is but slightly corrosive. They cannot be used to protect a steel shell for storing a material like 15 per cent uninhibited hydrochloric acid.

Unfortunately, resistance to the process fluid is not the only dimension to be considered in selecting materials. Cost per pound seems basic. Very often though, the fabrication is more costly than the material. As an example, some

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phenolic paints cost less than $2 per pound, but by the time they are applied they may cost up to $100 per pound.

Consider weldability . . . The ability to be fabricated readily is of tremendous concern. Particularly does modern design rely greatly on welded structures, and many of the highly corrosion-resistant materials are welded only with great difficulty.

Physical properties also need attention. First, there must be adequate tensile strength to withstand the loads imposed. Elementary indeed, until the ramifications of the joining method are considered! How can two pieces of porcelain be joined to give a leak-free joint having no significant loss in strength? How can high-strength aluminum be welded without a depreciation of the tensile strength? How can Hastelloy B be welded without extreme loss of ductility? So it goes through the whole roster of materials.

In much of the chemical and refinery work, ability to resist fire damage is a very important property. This is largely a function of the tensile strength and the short-time rupture strength at elevated temperatures. Creep, or cold flow, in the absence of fire is also not to be neglected.

Several other points to receive attention in the selection of materials are the ability to resist mechanical damage during cleanout and shutdown, the ability to resist thermal shock, and the ability to be repaired easily in the field.

Desirable materials . . . Table 1 reflects these various points in grouping the materials under "A," "B," or "C." The first group includes those commonly used in commercial equipment and which are readily fabricated. Group "B" includes those materials which can be fabricated into various parts but which are somewhat difficult to work or are expensive in first cost. Group "C" includes those applicable only with considerable difficulty or at high cost.

TABLE 1—DESIRABLE MATERIALS FOR CORROSION TESTING

Group A
Carbon Steel
Type 304 Stainless (18-8)
Type 410 Stainless (12 Cr)
Type 317 Stainless (16-13-3)
Inhibited Admiralty
Cupro-Nickel
Silicon Bronze
Aluminum Bronze
Monel
Steam Bronze (85-5-5-5)
Grey Cast Iron
Type 3S Aluminum
Group B
Type 347 or Type 321 Stainless
Type 430 Stainless (16 Cr)
Type 446 Stainless (27 Cr)
Hastelloy B
Hastelloy C
Copper
Lead
Inconel
Nickel
Polyvinylidine Chloride
Polyvinyl Chloride
Appropriate Rubbers
Group C
Titanium
Silver
Tantalum
Gold
Platinum
Glass Linings
Thin Organic Coatings
Porcelain
Graphite
Carbon
Sulfur
14% Si Iron
High Alloy Stainless Steels

One should keep in mind the possibility of bimetallic corrosion, corrosion-erosion, stress corrosion cracking, etc. However, it is almost impossible to make equipment out of only one material, as valves and pumps must have corrosion-resistant working parts.

Shutdown procedure affects equipment design to a marked degree, as serious corrosion often occurs during shutdown because corrosive agents are formed that never occur in the process fluid. For example air may get into the system and cause pitting of the copper alloy.

Avoid stress relieving . . . Since welding in new nozzles is done so frequently, shell thickness should be such that stress relieving will not be required afterwards or after making patches, etc. Welding processes also may affect corrosion, and automatic submerged-arc welds in carbon steel seem to be more subject to attack than manual welds when exposed to weak acids.

For services exposed to acidic environment, seamless pipe, which is made of killed steel, is the preferred material. From the standpoint of corrosion, there is little advantage in the use of good-quality pipe in the handling of such materials as aerated neutral water. The kind of steel seems to have little effect in determining the corrosion rate in this medium.

The great difference in physical properties among grades of pipe is manifest in the ability to withstand plastic deformation. The property of good ductility is required when the pipe is accidentally bent, when something falls on it, when men lean against it, when the fluid in the pipe freezes, or when the line is subject to overpressuring.

From the stand-point of ability to withstand plastic deformation, quality is generally in the following order:

Seamless pipe made of open-hearth or electric-furnace steel.

Seamless pipe made of deoxidized Bessemer steel.

Electric-weld pipe that has been expanded to final size.

Plain electric-weld pipe.

Lap-weld pipe.

Butt-weld pipe and continuous-weld pipe.

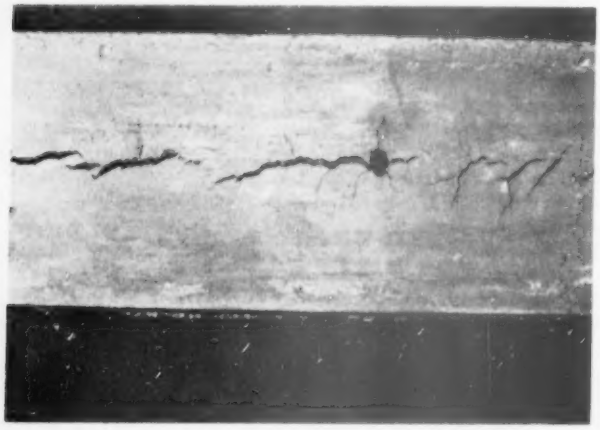
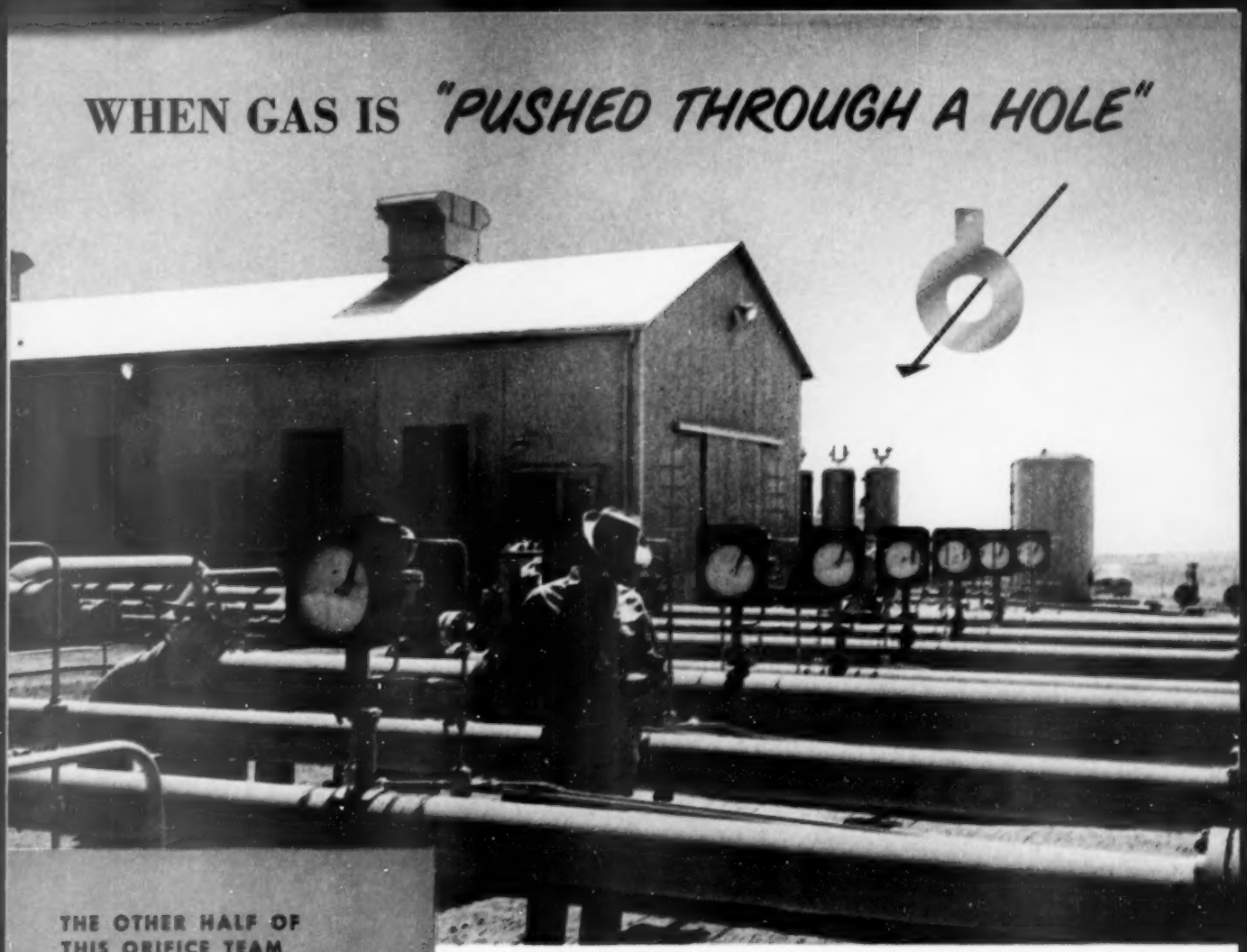


Fig. 1—This failure is due to stress corrosion cracking of the steel.

Fig. 2—This plug from a valve in hydrofluoric acid service failed from an embrittlement.

WHEN GAS IS *"PUSHED THROUGH A HOLE"*



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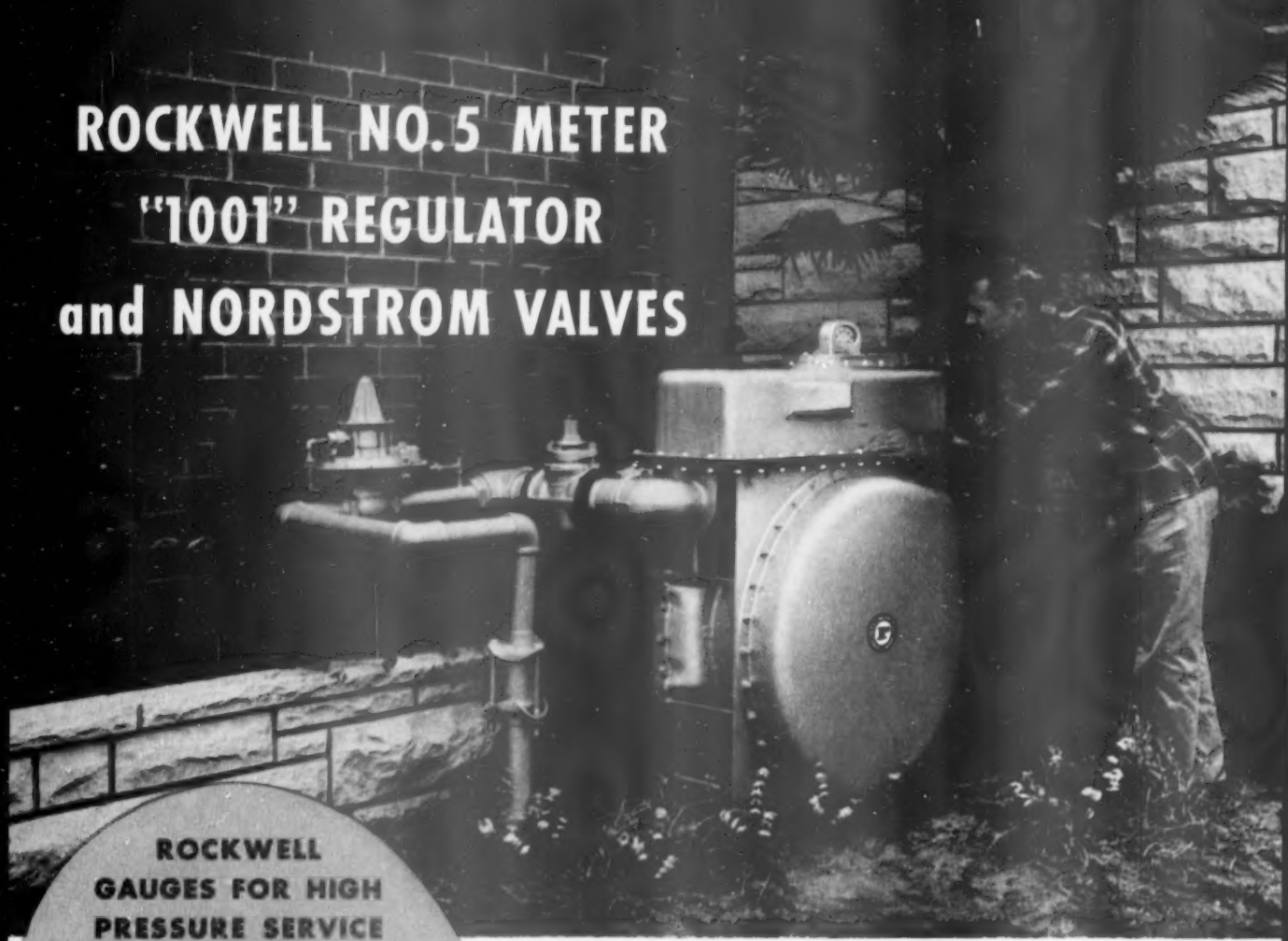

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COMBATING CORROSION . . .

Hot Coal-Tar Coatings Approach Ideal

It possesses the 10 characteristics desired in a protective coating

by N. T. Shideler

SOME of the characteristics to be desired in an ideal coating are these:

1. It should adhere tenaciously to the metal.
2. It should be nonabsorbent, impervious to water, moisture, vapors, etc.
3. It should have good dielectric qualities; not necessarily high but completely nonconductive.
4. It should be resistant to mineral acids, alkalis, salts, petroleum oils, etc.
5. It should be hard, yet flexible at temperatures between –40° and 300° F.
6. It should be unaffected by soil stresses and movement of the pipe and soils around it.
7. It should not permit penetration by stones, wires, welding rods, etc.
8. It should be easily applied, preferably without heat or primer.
9. It should be able to withstand bending and rough handling without damage.
10. It should give permanent protection to the metal at the least cost of application.

While no coating, whatever its composition, can measure up completely to these ideals, coal-tar coatings have proved the nearest approach in many applications.

Author is with Pittsburgh Coke & Chemical Co., Pittsburgh.

These coal-tar coatings are produced basically from the coal tar that is derived by the destructive distillation of bituminous and semibituminous coal. The coating, or enamel, may be divided into three ranges: narrow, wide, and moderate. The three names indicate the cold cracking and high-temperature sag range of the enamels.

The narrow-range enamels are manufactured from pitch and mineral fillers only. The pitch for this grade must be from a selected tar distilled to a specific pitch-softening point. Only a few of the many coal tars available are suitable for the production of this pitch. The pitch is produced in either a continuous or batch-type still.

The softening point selected is governed by the specification of the finished product and the rise in softening point brought about by the addition of the specific filler. In the plant, softening point of the pitch is controlled within a range of approximately 5° to 6° F. as is the final softening point of the enamel.

The wide-range enamels are produced from selected coal-tar pitch, coal-tar oil, crushed bituminous or semibituminous coals, and mineral filler. The process is much more complicated because of the crushed coal and the necessary processing.

A properly produced product is very stable, and retains all the good qualities of the narrow-range enamels plus the ability to withstand much wider temperature ranges. It is flexible, ductile, resists cold flow, etc.

Moderate-range enamels are produced by a modification of the wide-range enamels, or may be produced by blending the narrow-range enamels with the wide-range enamels, in the ratio of approximately 40 per cent narrow to 60 per cent wide-range enamel. The characteristics of these enamels are about the middle between the other two enamels.

Primer . . . The primers are made from the same base pitch as the enamels. That is, for narrow-range enamel, a straight pitch of softening point (Ring and Ball) between 145° to 185° F. is used. Crude coal-tar solvent distilling between 150° and 200° C. is blended with the melted pitch in sufficient quantity to produce a thin, fluid, paint-consistency product that will dry rapidly on application to metal surfaces. The softening point of the pitch, viscosity of the product, drying time, and bonding characteristics are carefully controlled. After blending, the product is cooled, viscosity is adjusted, completely tested, then drummed.

The moderate and wide-range enamel primers are made by using the same coal-tar solvent as for the narrow-range enamel. The pitch used is the basic pitch of the enamel without the filler. Because of the presence of the coal in these products, the finished primer is not a solution of the pitch in the solvent as is the narrow-range primer, but more nearly approaches, and probably is, mainly a dispersion of the pitch in the solvent.

Why three ranges? . . . During the application of enamels to oil and gas-transmission lines for the most part the pipe is coated over the ditch or at the side, and the pipe is usually in the ditch and backfilled within 2 or 3 days. In addition, the coatings are usually applied when temperatures are above 32° F., thus avoiding cracking in cold weather. During the short time of exposure to summer heat and because of the usual use of felt, glass, or kraft

TABLE I

Enamels	Narrow Range Min.	Narrow Range Max.	Moderate Range Min.	Moderate Range Max.	Wide Range Min.	Wide Range Max.
Spec. gravity 25° C.	1.40	1.50	1.40	1.50	1.40	1.50
Softening point A.S.T.M. D-36-26° F.	180	200	180	200	220	
Penetration A.S.T.M. D-5-25						
100 g. 5 sec. 77° F.	0	2	2	6	7	20
50 g. 5 sec. 115° F.	0	8	10	30	14	50
Ash, mineral filler residue on ignition A.S.T.M. D 271-37%	15	35	15	30	20	35
Sag test: 3/32-in. coating on 12 by 7/32-in. steel plate in oven at prescribed temperature, vertical						
5 hours at 120° F.	1/32 in.					
5 hours at 130° F.			1/32 in.			
24 hours at 160? F.					1/32 in.	
Cold test. Run on plates after sag test						
5 hours at 30° F.	(*)					
5 hours at 0? F.			(*)			
5 hours at –20? F.					(*)	
Stripping test: Peel test 3/32 in. by coating on ½ by 12 by 12-in. steel plate, plate tested after pouring and at each 20° F. increment up to sag temperature, 1 hour at each temperature	†		‡		§	

*No cracking or disbonding. †⅛ in. max. to 120° F. ⅛ in. max. to 130° F. §⅛ in. max. to 160° F.

wrapper there is little danger of flow or sagging of the coating because of heat.

This application can be well filled by the narrow-range enamel.

At temperatures below 30° F., however, coating is subject to cracking and disbonding, for the coating cannot withstand low temperatures. The coating has certain characteristics that fit it admirably to oil and gas applications such as quick setting after application, high hardness, ease of application, no trouble to remove from the drums, easily broken up, easily melted and heated, and once in place in the trench, below the frost line and backfilled, gives excellent protection.

Wide-range enamels have wide temperature range susceptibility of minus 20° F. cold without cracking and 160° F., heat without sagging. These may be exposed to atmospheric temperatures given above for days, weeks, or months. It is essential that the coating stand the cold of winter without cracking, and the summer heat without flowing or sagging from the pipe.

The fact that this grade of coating can stand such conditions makes it suitable for those applications in early spring, late fall, or winter months when lines must be coated and installed in such weather. Again the coating has sufficient hardness and also flexibility at ground temperatures below the frost line to resist puncture by stones and various things in the backfill, resist soil stress, and is just as capable of giving lasting service to the oil and gas lines as the narrow-range enamels.

It does have some disadvantages. Because it is flexible, ductile, and a softer coating, it is very soft at summer temperatures. In the hot sun where pipe temperatures in the middle of the day may reach 160° F. the coating may flatten out where the pipe rests on the skids, so much so that holidays may result at these spots. Despite this, a large amount of this coating has and is being used quite successfully.

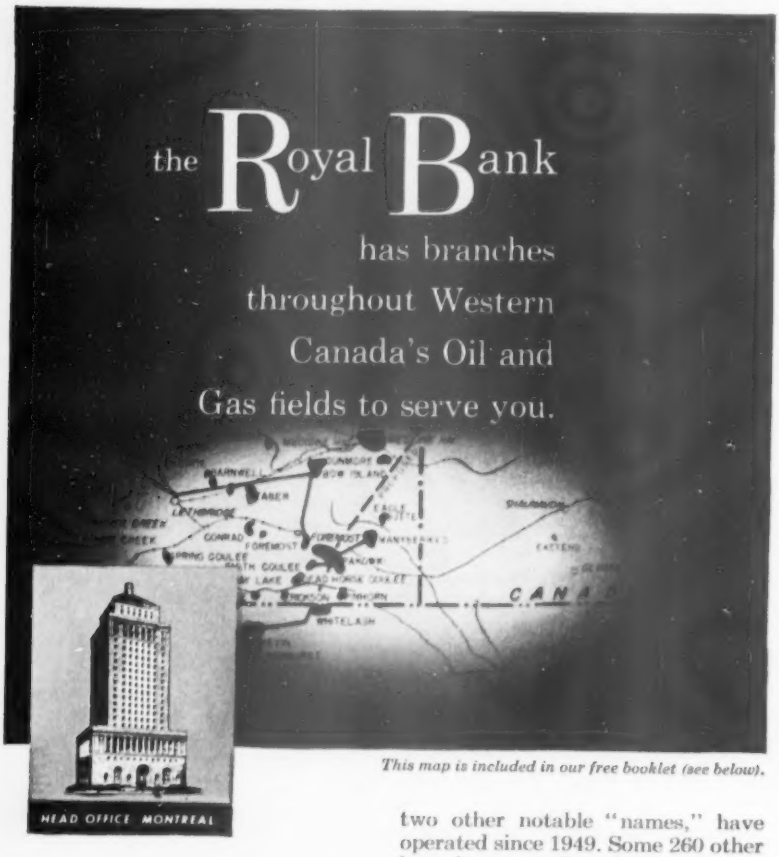
Moderate-range coatings have been used mainly in coating plants where the pipe is primed and coated in short sections and shipped to the job site. This coating will withstand zero temperatures without cracking and to 140° F. without sagging. This coating is only slightly softer than narrow-range enamel, much harder than the wide-range, so that for summer application it eliminates the major difficulties of the wide-range enamel and will withstand the lower temperatures that destroy the narrow-range enamel. It comes more nearly being an all-weather coating and fills a definite need in the oil and gas industry.

Specifications and tests . . . The specifications in Table I are of wider limits than normal as they are made to include the products of all manufacturers.

Softening point is very important, for softening point in conjunction with penetration and ash determines the performance of the product. This goes only in one direction; if a coating is off specification it is better to have the softening point go higher rather than lower. Lower softening point usually means that the cold-flow characteristics are increased. Softening point gives a fairly good guide to the application temperature of the coating.

Ash or mineral filler is important because too little will yield a brittle product, while too much renders the coating too viscous at application temperature. Filler content also affects the softening point; the higher the filler content the lower the softening point required for the pitch from which the coating is produced.

Penetration is all important when considered with the softening point of the moderate and wide-range enamels.



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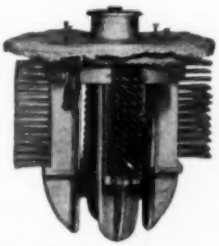

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QUICK, EFFICIENT MARINE REPAIRS

The ratio of the two penetrations in conjunction with the softening point somewhat controls the sag-test temperature and the cold-cracking temperature of the coating. To the consumer it is of interest because it gives him concrete evidence regarding the amount of change in softness of the product with change in temperature.

The narrow-range enamel cannot be changed too much by the manufacturer except from the standpoint of softening point and filler content. Going over the specified softening point increases slightly the brittleness of the product and raises its cold-cracking temperature. Normally, an overstepping of the maximum softening point does not radically raise the cold-cracking temperature. However, going below the minimum softening point does decrease the cold-cracking temperature and also increases the cold flow of the coating.

The softening-point range and filler content of the moderate-range and the wide-range enamels are just as important as for the narrow-range product. However, overstepping the softening point does not usually affect the cold-cracking temperature if the penetration is within range. Penetrations are very important for they are a measure of the softness of the product.

If a moderate-range enamel is purchased on the specification of a 2 to 6 penetration range at 77° F. and is strictly adhered to by one manufacturer while another supplies the same softening point product but the penetration is around 10, then the second product is going to be much softer on the pipe and in warm weather application will set up slowly, squeeze out, and jeep under the skids.

If the in-service line temperature is high, then the same coating will be soft and subject to puncture and to soil stress to a much greater extent than the originally specified material. This is particularly true of the moderate and wide-range products.

With the wide-range product a penetration of below 7 normal means that the product will crack at minus 20° F., yet even at a 2 penetration it should still pass a minus 15° F. cold test. Owing to normal in-service pipe-line temperatures, it would be better to sacrifice the 5° cold-cracking temperature with lower penetration than to have a higher-than-specification penetration with consequent softness.

Tank bottoms . . . Coal-tar coating for crude-oil storage tanks is similiar to the narrow-range enamel in that it must be made from coal-tar pitch and mineral filler without the addition of any excess or additional oil.

This product is easily applied and when properly applied to the bottom and bottom side ring of crude-oil storage tanks gives excellent protection.

For many years the narrow-range enamels were used for this purpose but because of their high cold-cracking characteristic could not be used in colder climates. One might wonder why the wide-range enamel would not be ideal for this service. Due to the raw materials used in the wide-range enamels, crude oils containing some aromatics dissolve the oils from the coating causing them to shrink, crack, and disbond.

Carl Miller reports the loss in weight due to leaching of the coal-tar oils from the normal coal-tar enamels from 16 weeks' immersion in crude petroleum oil as follows:

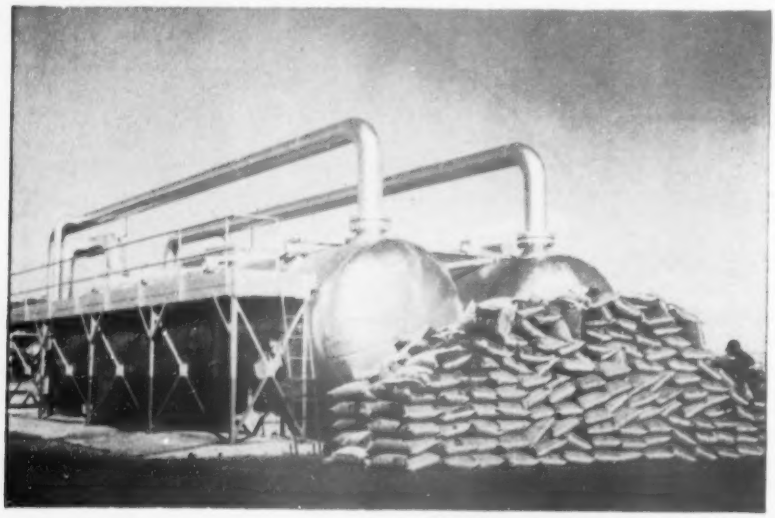
Wide-range enamel, 32 per cent loss.

Moderate-range enamel, 16 per cent loss.

Narrow-range enamel, 3 per cent loss.

We have verified this.

The solvent action of the crude oil thus eliminates the use of the normal coal-digestion products as well as solvent cutback mastics and any slow-drying cold-applied coatings.



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Cleaning . . . Most line cleaning and priming machines using rotating cutters and brushes remove practically all the rust, scale, and dirt, leaving only a few pin-point rust spots in depressions on the pipe. For all practical purposes, a cleaning operation that leaves a bare metal surface, whether smooth or rough, is satisfactory for coal-tar-coating application.

The narrow-range primer, unlike the moderate and wide-range primer, changes viscosity rapidly with change in temperature; that is, as the temperature of the primer and pipe falls below the minimum normal of about 65° F. the primer becomes viscous or thickens so much that at 30° F. it cannot be poured from the drum. If applied at these lower temperatures without thinning, the primer applied is too thick, resulting in a greatly increased drying-time requirement. Even if the primer is warm and the pipe cold, the primer is cooled so quickly by the metal that the application is still too thick. Doubling the thickness often quadruples the drying time.

Cold-weather applications of primers are particularly bad because the primers may feel dry and hard on the cold pipe, yet still retain considerable solvent. It is true that the narrow and moderate-range enamels can absorb small amounts of solvent from primer that is not quite dry, but the wide-range enamels must be applied over fully dried primer.

Primers are said to "go dead". This condition usually occurs in summer with high temperatures or on primer that has been on for a long time. The primer becomes hard, brittle, and may even flake from the pipe. All primers will go dead eventually but the time of going dead depends upon the nature of the primer and exposure conditions. Time may be anywhere from 3 hours to 1 year.

Application of Hot Coating

In the mill and field so many things enter into and affect the application temperature that the best the coating manufacturer can do is state an average application temperature, which will be correct within a range of possibly plus or minus 50° F. In general, application temperatures of the coatings are approximately 225° F. above the coating softening point.

Increased softening point and decreased penetration, due to overheating, means that the coating cannot stand as low a temperature without cracking as it is supposed to stand. Each per cent of oil lost by weight means raising the cold cracking temperature about 3° F.

Jeeping . . . With many people use of the holiday detector has become a dielectric strength measurement or thickness of coating measurement instead of its primary purpose of locating voids in the coating. Thickness is measured by other means and dielectric measurements require voltages high enough to break down the coating. It is not the desire to break down the coating but to find voids.

Since voids are the only purpose of the jeep, use only sufficient spark length to seek out the holes, and a minimum amperage to prevent burning the coating and at the same time be safe for the operator to use.

Patching . . . If a different grade is used for patching, it will frequently result in cracking in cold weather due to uneven stresses set up between the different coatings.

Although the wide-range-coating is –20° F., the pipe cannot be handled at that temperature, the cold-test temperature is the safe low temperature that the coating can stand when the coated pipe remains undisturbed at the temperature and does not crack or injure the coating. This coating on pipe must

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be handled with extreme care even at plus 20° F.

Fluxing . . . The addition of flux oil to the coatings to permit their application at lower temperatures is never to be recommended. Addition of flux lowers the softening point and increases the penetration and may eliminate application difficulties due to low atmospheric temperatures. However, the addition is at the same time lowering the performance characteristics of the coating. The decreased softening point and increased penetration results in softer coating on the line, less resistance to soil and pressure stresses, and less resistance to high-line temperatures. Fluxing is to be avoided, if at all possible.

Right Metals Insure Long Life

By Wayne Z. Friend

THE selection of materials of construction for chemical process equipment depends upon a number of operating factors such as: nature and concentration of the corrosive, temperature, degree of aeration, velocity, and the presence of minor chemicals which may in some cases act to increase corrosion and in other cases may act to inhibit corrosion.

Plant operating experience has established the conditions under which each type of metal or alloy is likely to be most suitable. Favorable and unfavorable exposure conditions exist for the principal groups of metallic construction materials including:

Copper and high-copper alloys.
Lead and lead alloys.
Nickel and high-nickel alloys.
Stainless steels.
Steel, cast iron, and iron-base alloys.

Author is with International Nickel Co., Inc., New York.

Galvanic Anodes Reduce Underground Corrosion

By Robert L. Featherly

PAST field applications in both underground and underwater service have proved galvanic anodes able to prevent much corrosion. Factors to be considered in any proposed installation are the determination of current requirements, selection of materials, proper engineering design, and economical installation practices.

Author is with Dow Chemical Co., Midland, Mich.

Cathodic Protection Saves Bare Lines

By Jay R. James

WITH proper interpretation of the results of modern methods of surveying bare underground structures, a cathodic-protection system may be instituted to prevent excessive corrosion. In conducting a soil resistivity survey by the "spot" method, two men might cover 3 to 3½ miles per day; while with a combination pipe locator and spot method, they might average 5 miles per day.

Author is with Cathodic Protection Service, Tulsa.

Physiochemical Factors In Corrosion

By Norman Hackerman

THE corrosion engineer should know the various phases in the corrosion reaction, the chemical and electrochemical mechanisms of both dry and wet reactions. From these factors he will get the indicated directions for corrosion mitigation.

Author is with Department of Chemistry, University of Texas.

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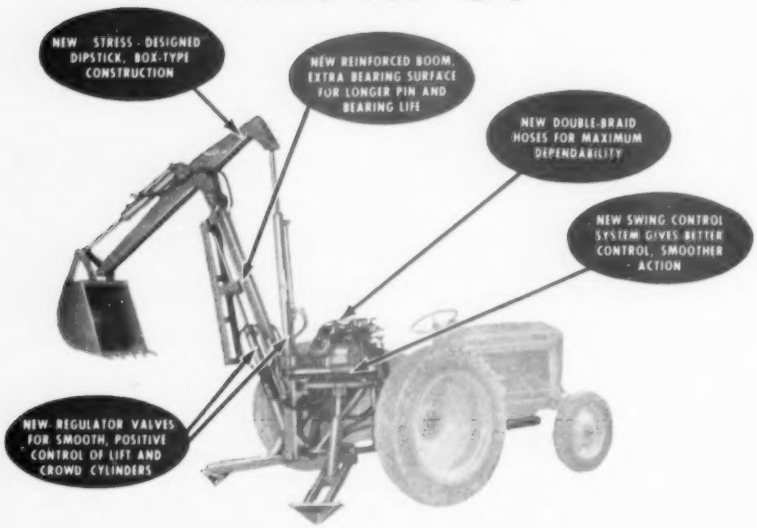
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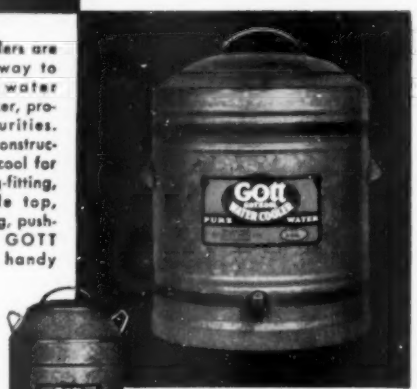

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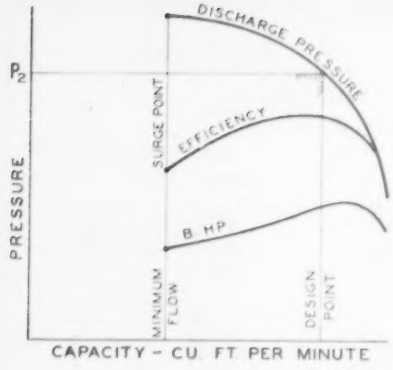

Fig. 1 — Typical compressor head-capacity curve.

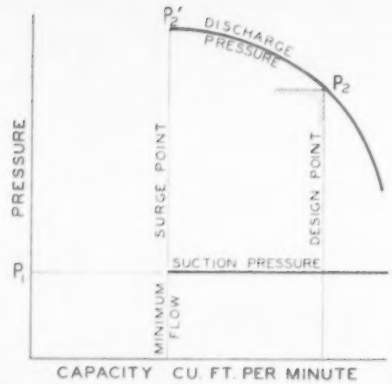

Fig. 2—Typical compressor suction and discharge-pressure presentation.

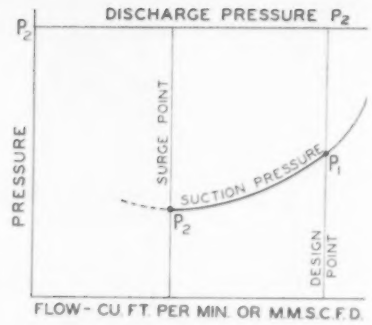

Fig. 3—Compressor suction and discharge-pressure presentation for pipe-line application.

Here's how to adapt

Centrifugal Compressor Performance Curves

to pipe-line applications

by Harold Woodhouse

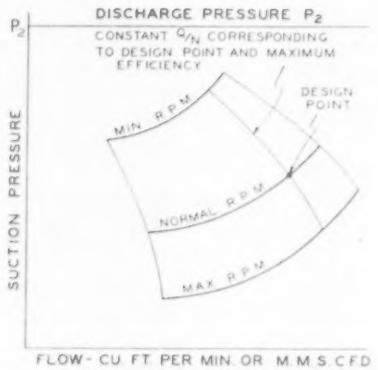

Fig. 4—Compressor range of operation at variable r.p.m. for pipe-line application.

EVER since their introduction in the early part of this century, the designers and manufacturers of centrifugal blowers and compressors have been accustomed to presenting their performance characteristic curves in the standard manner which is based on constant suction pressure and variable discharge pressure as illustrated by Fig. 1.

1. Pressure ratio . . . At the point of operation for which the compressor was designed (see Fig. 2), if we assume P_1 as the constant suction pressure the pressure ratio is:

$$\frac{P_2 \text{ abs.}}{P_1 \text{ abs.}}$$

but for the point of greatest discharge pressure P_2' abs.—which corresponds to the point of minimum flow at which the compressor can operate due to the onset of a pulsating phenomenon known as "surging"—the pressure ratio is:

$$\frac{P_2' \text{ abs.}}{P_1 \text{ abs.}}$$

or, in other words, for every rate of flow there is a corresponding pressure ratio of compression. This curve which defines the pressure ratio at a given flow is generally known as the "head capacity" curve. "Head" is almost synonymous with "pressure," but not quite, for blowers or compressors. For centrifugal pumps handling cold or cool water, for instance, one converts head in feet into pressure in pounds a square inch by dividing the head by 2.31.

Due to the variable specific volume of a gas undergoing centrifugal compression, the polytropic head H_p and discharge pressure P_2 are related by the formula:

$$H_p = \frac{RT_1Z}{M}\left[(P_2/P_1)^M - 1.0\right]$$

where:

R = gas constant $= \dfrac{1{,}545}{\text{Molecular wt.}}$

Z = supercompressibility factor

$M = \dfrac{(k-1)/k}{\eta_p}$, where k = ratio of specific heats = Cp/Cv and η_p = polytropic efficiency of the compressor

Now that the future is assured for the centrifugal compressor in the pipe-line business, the designer finds that he must present his performance curves in a manner which is foreign to all his past experience. And to the pipe-line operator the performance characteristics of the centrifugal compressor must often seem quite mystifying.

2. Variable suction pressure . . . If we convert the suction and discharge pressure curves of Fig. 2 so that the compressor operates against constant discharge pressure with a variable suction pressure we will have the curves as shown by Fig. 3. If the compressor were the same for Figs. 2 and 3 and if P_2, P_1, the speed and the type of gas were all identical, then the efficiency, horsepower, and flow would also be identical at the design point. At all other points of operation below normal flow there would be deviations due to the lower suction and discharge pressures for Fig. 3.

3. Operating speed . . . If the suction pressure curve of Fig. 3 is considered as being for normal operating speed we can construct Fig. 4 showing the limits of operation when the compressor speed is changed from minimum to overspeed. The amount of speed variation is al-

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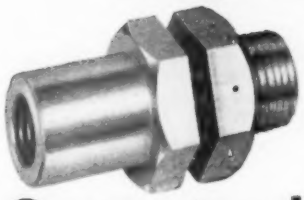

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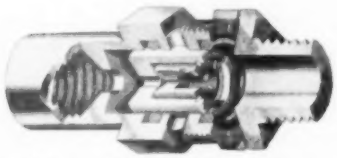

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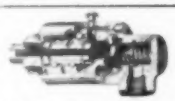

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Fig. 5—Compressor efficiency at varying load coefficient Q/N.

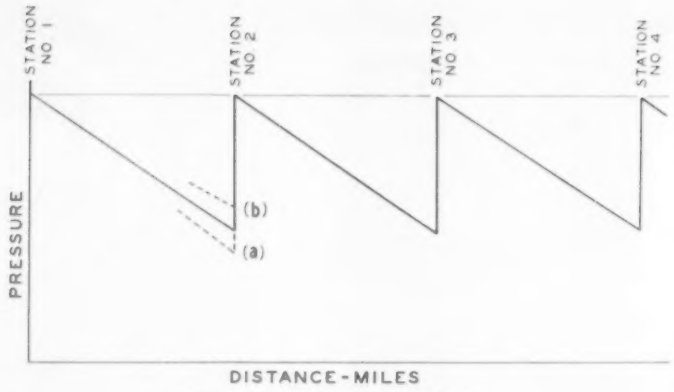

Fig. 6—Pipe-line pressure distribution.

most entirely dependent on the type of prime mover being used. With a turbine the minimum would probably be 70 per cent of normal and the maximum 110-115 per cent of normal. With an electric-motor drive the speed is constant.

4. Load coefficient . . . Superimposed on Fig. 4 is the line of constant Q/N for maximum efficiency and this should pass through or near to the designed point of operation A at normal speed. Q is the flow in cubic feet per minute and N is the revolutions per minute. So the Q/N value is the amount of gas which a particular compressor will deliver for each revolution of the impeller. It is independent of the kind of gas and its pressure. Its importance is that any point on this constant Q/N line should have the same efficiency. For identical Q/N values the compressor is said to be operating at "synchronous" speeds since the flow conditions with regard to the impeller and diffuser, or the impeller and volute will be identical and it is these conditions which determine the efficiency.

Fig. 5 is a typical plot of Q/N versus efficiency and it may be seen that a flat Q/N curve is desirable over the expected range of operation to maintain maximum efficiency.

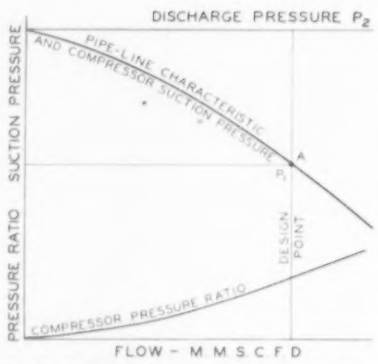

Fig. 7—Pipe-line characteristic for a given station spacing, compressor suction pressure, and pressure ratio P_2/P_1 for variable flow.

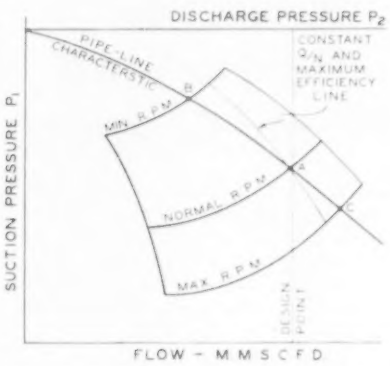

Fig. 8—Superposed pipe-line characteristic and compressor range of operation at variable r.p.m.

5. Pipe-line pressure distribution . . . Plotting the pressure distribution in a typical pipe line over a distance encompassing several compressor stations we will have a zig-zag curve of the form shown in Fig. 6. The curve as shown applies to only one rate of flow. For a greater rate of flow the curves will be steeper and the suction pressure at each station would be as marked at point (a) and for a smaller rate of flow the suction pressures would be as marked at (b).

6. Pipe-line characteristic . . . If we

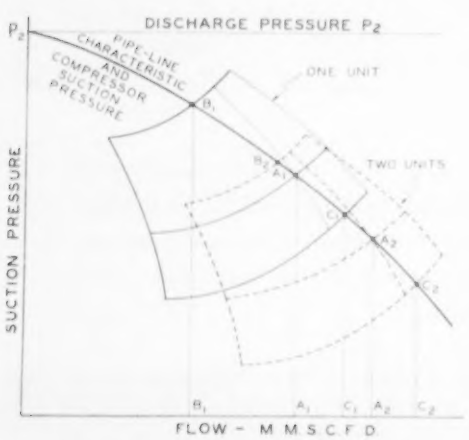

Fig. 9—Two centrifugal compressors in series.

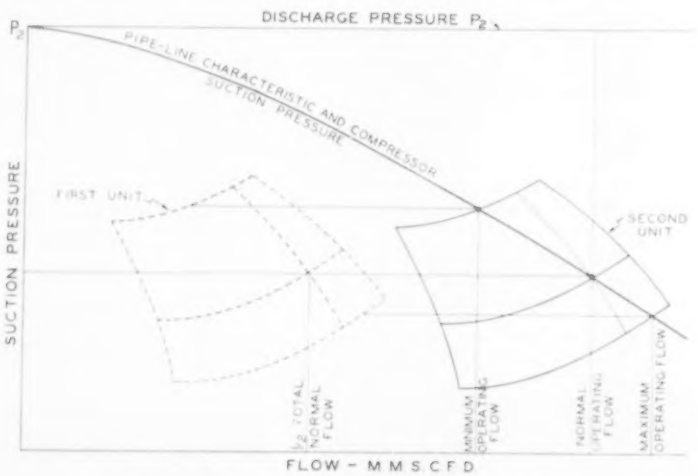

Fig. 10—Two centrifugal compressors in parallel.

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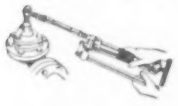

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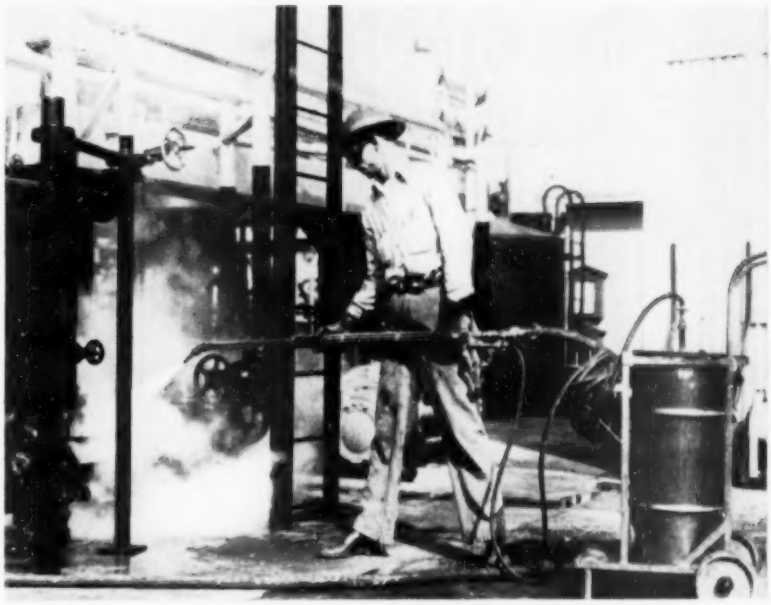

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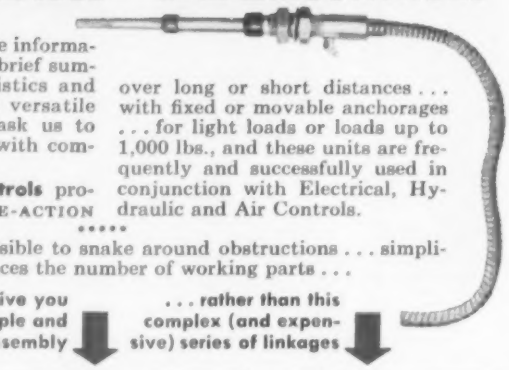

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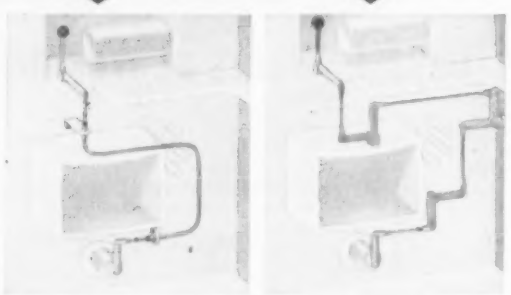
to give you this simple and effective assembly ↓ **. . . rather than this complex (and expensive) series of linkages** ↓



POSITIVE REMOTE-ACTION and FLEXIBILITY together with Precision and Long Life, explain why TRU-LAY PUSH-PULLS serve designers and users equally well in improving machine operations, whether the application is on such severe service jobs as Bulldozers, Power Shovels and Steel Mill Machinery, or on such light duty work as Photographic Equipment, X-Ray or Business Machines.

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THE AUTHOR

Harold Woodhouse is chief engineer for Dean Hill Pump Co., which position he has held since 1950. He is also consultant for Cooper-Bessemer Corp., supervising the design of pipe-line centrifugal compressors. Prior to his association with Dean Hill, he was general manager and chief engineer of Power Generators, Ltd., where he supervised design of high-pressure and high-temperature turbines and centrifugal pumps for the U. S. Navy. Woodhouse has also been director of engineering for the Stratos Division of Fairchilds E. & A. Corp., and has been associated with the DeLaval Steam Turbine Co.

plot the suction and discharge pressures versus flow at any one of these stations we will have the curves as shown in Fig. 7. For a flow corresponding to Point A on the suction pressure curve the pressure ratio required from the compressor to deliver gas at a pressure P_2 from the station to the next section of pipe line is P_2/P_1.

If the Point A in Fig. 7 corresponds to the designed point of operation at normal speed for the compressor of Fig. 4 and the curves are plotted to the same scales we can superimpose Fig. 4 on Fig. 7 so that points A coincide. This is as shown in Fig. 8.

The compressor must perform according to the conditions as presented to it at its suction flange, therefore, over its complete range from minimum to overspeed, its suction condition will always be somewhere on line BAC. In practice, due to the many variables over the entire pipe line, there will be variations in the suction and discharge pressures from the theoretical but, if the discharge pressure is the ceiling limit for the pipe constituting the pipe line, the company dispatcher will make every effort to see that this value is not exceeded on any part of the line. The suction and discharge pressures at a particular station would tend to go up and down with the discharge pressure at the next upstream station.

It will be noted that the constant Q/N line diverges from the suction pressure line for both reduced and overspeed conditions. In such circumstances it is an advantage to have a flat Q/N curve as shown in Fig. 5 so that the compressor efficiency does not suffer at other than normal conditions.

7. Compressors in series . . . If it is desired to increase the flow in the

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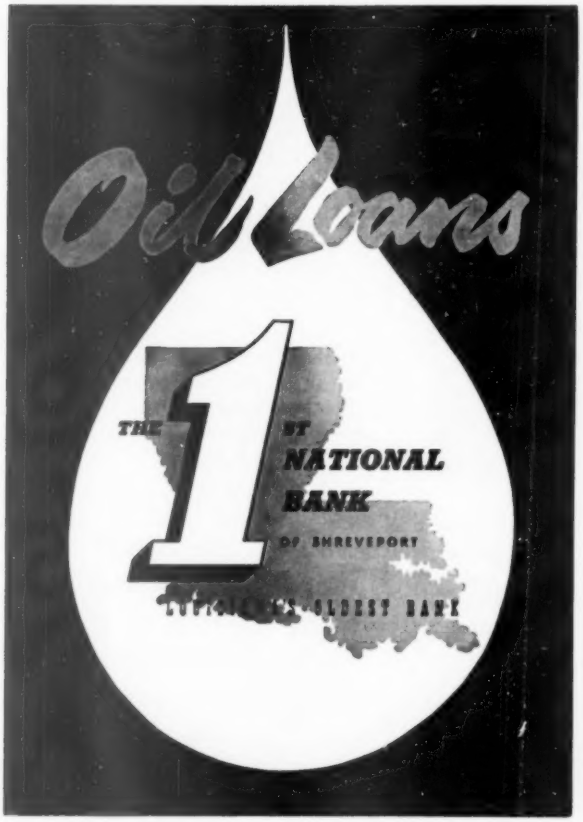

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pipe line it is the most common practice to put several compressors in series in the same station, that is, all of the gas coming into the station is passed successively through a number of compressors.

Fig. 9 shows the performance range of either one variable speed compressor or two in series.

With one unit the total range of flow which can be handled corresponds to Points B_1 and C_1. With two units available the total flow range is extended from $B_1 C_1$ to $B_1 C_2$.

With two units in series operating at a given instant at Point A_2 the station pressure ratio is P_2/P_{A2}

If they are similar compressors with the same impeller outside diameters and the same r.p.m., then each compressor will be contributing approximately $\frac{1}{2}$ (P_2/P_{A2}). As it is not unusual for a compressor station to have five units in series (with one as standby) there is an advantage in having to produce only one-fourth of the total pressure rise in each unit since it means that neither the impeller outside diameters nor their tip speeds have to be very large, thereby reducing the size of the units and making high efficiencies possible.

There is seen to be some overlapping from B_2 to C_1 of the operational ranges possible so that one unit could handle at overspeed what two units can take care of at reduced speed. This is necessary to cover fully all possible rates of flow.

8. Compressors in parallel . . . While centrifugals have generally been used in series on pipe lines they can be used in parallel using different control methods.

Fig. 10 illustrates two units in parallel.

One disadvantage of parallel operation for centrifugals is that each compressor must develop the full station pressure ratio. This leads to large diameter and more expensive impellers or to higher speeds since pressure ratio is a function of impeller-tip speed.

Another disadvantage is that compressor efficiency tends to decline with higher impeller-tip speeds and there has been a very strenuous effort made to make pipe-line centrifugals highly efficient. To achieve this the tip speeds have been held to the ultraconservative values of 380-520 ft. per second with 40-50 ft. per second gas velocity at the suction flange and 75-80 ft. per second at the impeller inlet eye.

As with centrifugal pumps in parallel, special attention must be paid to the characteristic curves of centrifugal blowers in parallel and special controls are required to keep the loads properly distributed.

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Pipe-Line Patrol

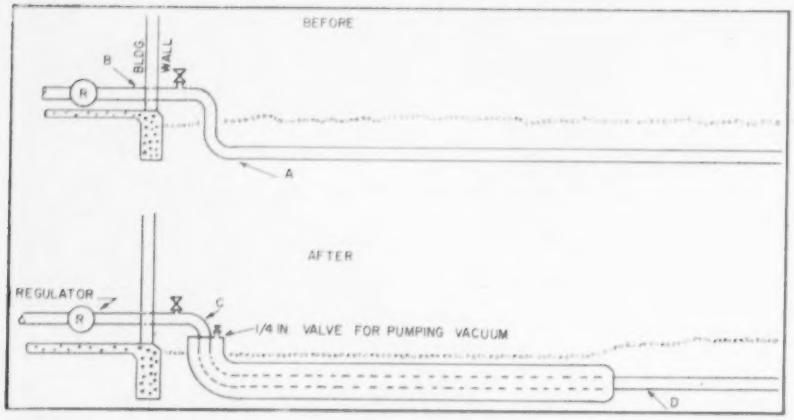


Fig. 1—Casing is welded gastight around gas line for a short distance downstream from regulator building. Note valve connection for pulling vacuum on annulus.

Vacuum Jacket Prevents Heaving

. . . and consequent damage to building walls

MANY gas men have been confronted with the danger and damage resulting from heaving of lines and fittings as a result of frost formation on the outside of gas piping downstream from large pressure "cuts." Such frost formation and heaving are particularly damaging to brick or tile walls and foundations where piping passes through the walls and into the ground outside of the building downstream from the pressure regulators.

In an effort to overcome one of these frosting and heaving conditions which threatened damage to the wall of a tile regulator building during the winter of 1951-52, United Natural Gas Co., Oil City, Pa., welded about 30 ft. of 16-in. pipe around the 6-in. pipe carrying gas downstream from the regulators so that it was gastight and pumped a few inches of vacuum on the annular space. This created a "thermos" effect at the point where the pipe entered the ground and thus prevented frost formation and consequent heaving of the pipe in the proximity of the regulator building. Gas pressure at this location was reduced from approximately 550 psig. to 110 psig.

Fig. 1 is a diagrammatic sketch showing operating conditions before and after installation. Fig. 2 shows the ice formation on the 6-in. pipe at the inlet to the 16-in. vacuum jacket and the absence of frost on the 16-in. itself. Fig. 3 shows the vacuum jacket which is completely frostfree. Heaving of the ground started at the outlet of the jacket and extended downstream for approximately 1,000 ft. Fig. 4 shows exposed portion of vacuum jacket after ground had been replaced and illustrates the protection to the building wall by elimination of the heaving action nearby. Frost on the pipe where it passes through the wall of the building is removed occasionally by applying a little methanol from a squirt can on the ice at this point.

Results of this experiment were entirely satisfactory.

This same principle was used at a road crossing where frost action on the outside of a gas line had caused heaving and breaking of the concrete surface of a paved highway. In this case, however, it was not necessary to pump a vacuum on the annular space between the gas line and the conduit pipe since the dead air space, vented at each end of the conduit, was sufficient to protect the roadway from frost penetration.

The principle is not new but the application appears to be a simple remedy to a problem which has plagued the gas operator for a long time.

Of course each case is an individual one, depending upon depth of present pipe, soil structure, pressure drop, etc., but it is felt that the method described is worthwhile in all cases similar to the one cited. Use of this relatively inexpensive maintenance procedure should enable gas-distribution companies to eliminate costly damage to station buildings and station areas.

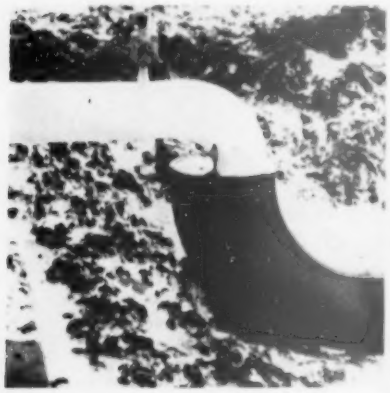
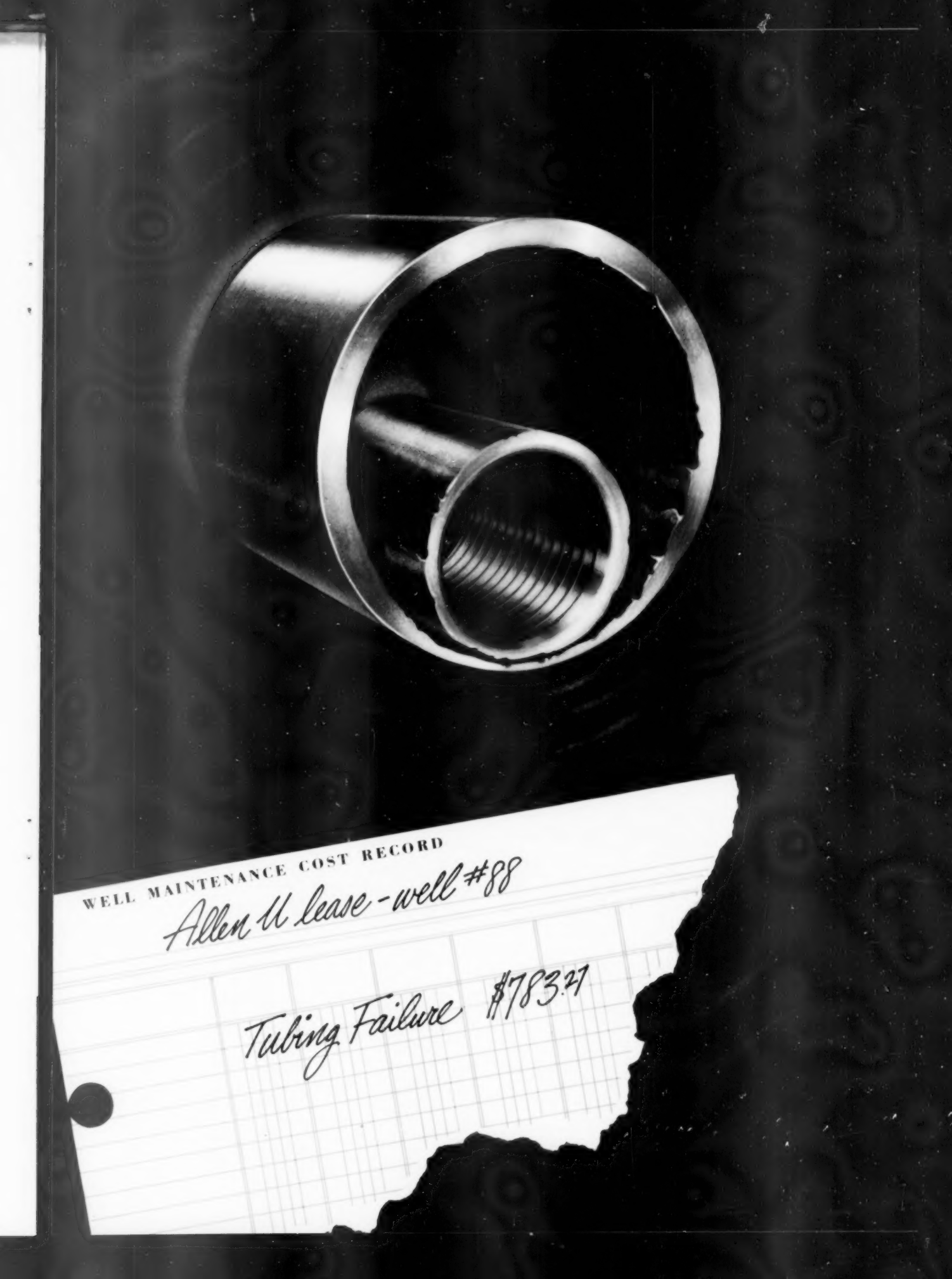


Fig. 2—Frost forms rapidly on portion of line not cased, as shown here.

Fig. 3—No frost is evident on casing because of a "thermos" effect.

Fig. 4—Even with very heavy frost on the bare line, the casing is still frostfree.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2 Special dolly facilitates handling of the inside lineup clamp at welding "tables."

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TYPICAL steps of operation conducted by H. C. Price Co., in manual double-jointing about 110 miles of 24-in. pipe for Southern Natural Gas Co., are shown here.

Pipe was rolled at Republic Steel Co. mill at Gadsden, Ala. The 27 to 31-ft. random lengths of pipe were then hauled to the double-jointing rack. The rack was fabricated out of old street-car rails, laid on railroad ties. The pipe is rolled onto 400-ft.-long runs. When it reached the line-up tables two lengths were brought into position for application of the stringer bead. Two such tables permitted the handling of approximately 450 lengths of pipe daily.

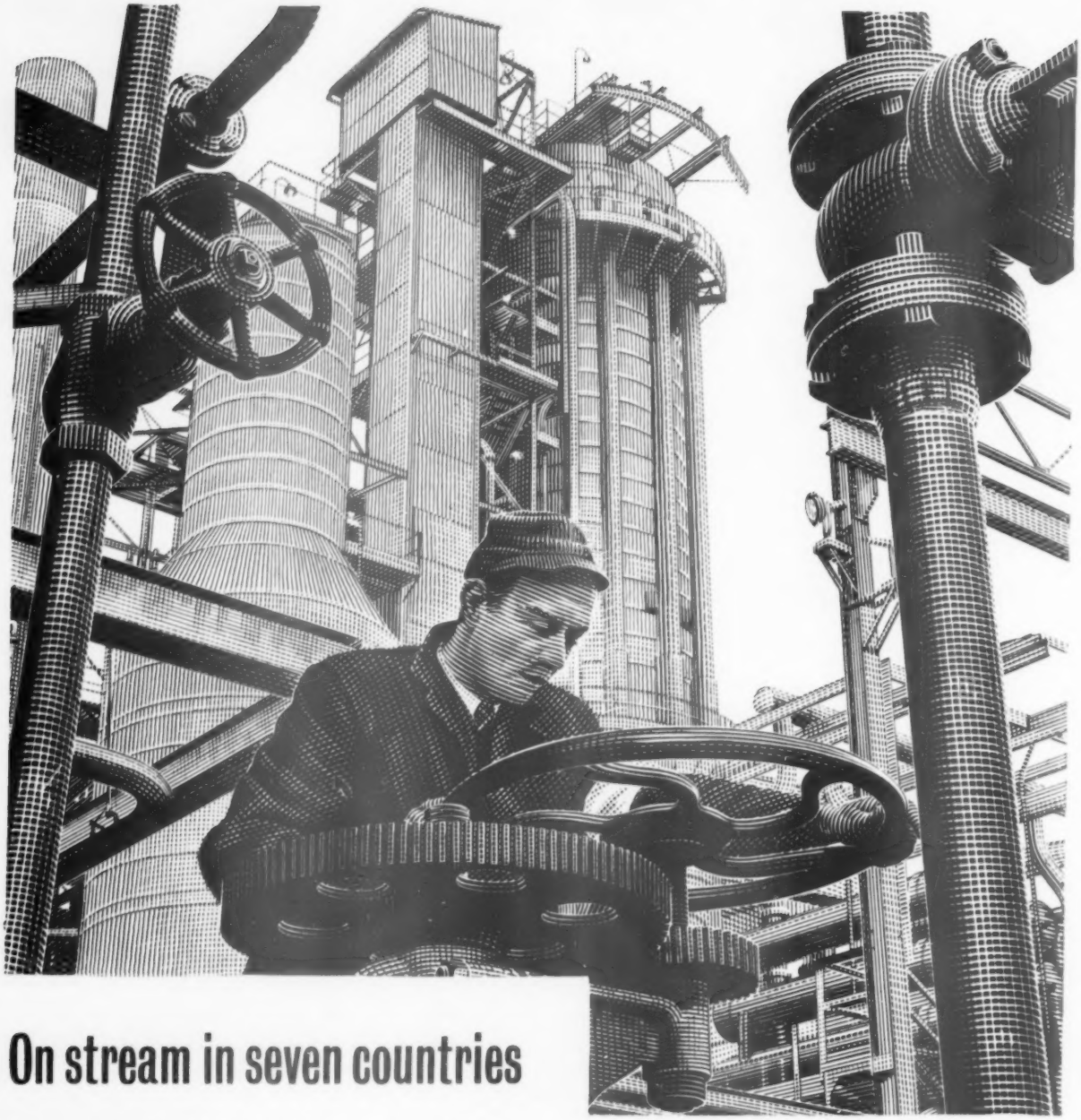
After it leaves the line-up table, the double-joint is rolled to a second position for application of the filler bead.

3 Two lengths of 24-in. pipe are brought into position for the double-jointing operation.

4 Team of welders apply the stringer bead, using 5/32 No. 5 fleet weld, at lineup table.

5 Stringer bead is burnished with rotary grinder, insuring removal of all slag and oxidation.

6 Pipe is rolled to second position for application of filler bead and cap weld. Final weld inspection is made here.



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International Engineering Associates, New York

THE chart below permits rapid determination of amount of heat that must be removed from the oil to congeal a desired percentage of wax present in lube-oil dewaxing operation. Example for use with this chart will be given in a later installment of this feature.

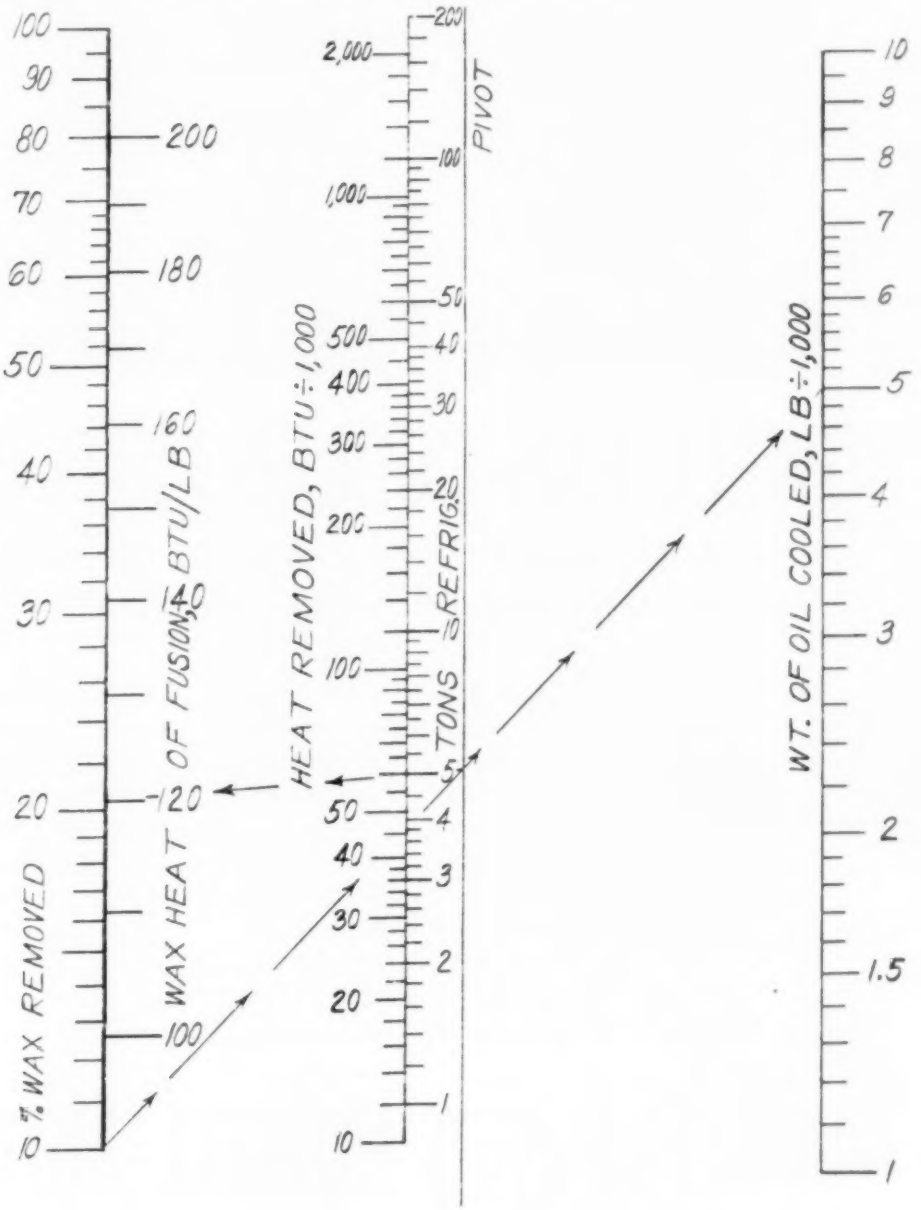
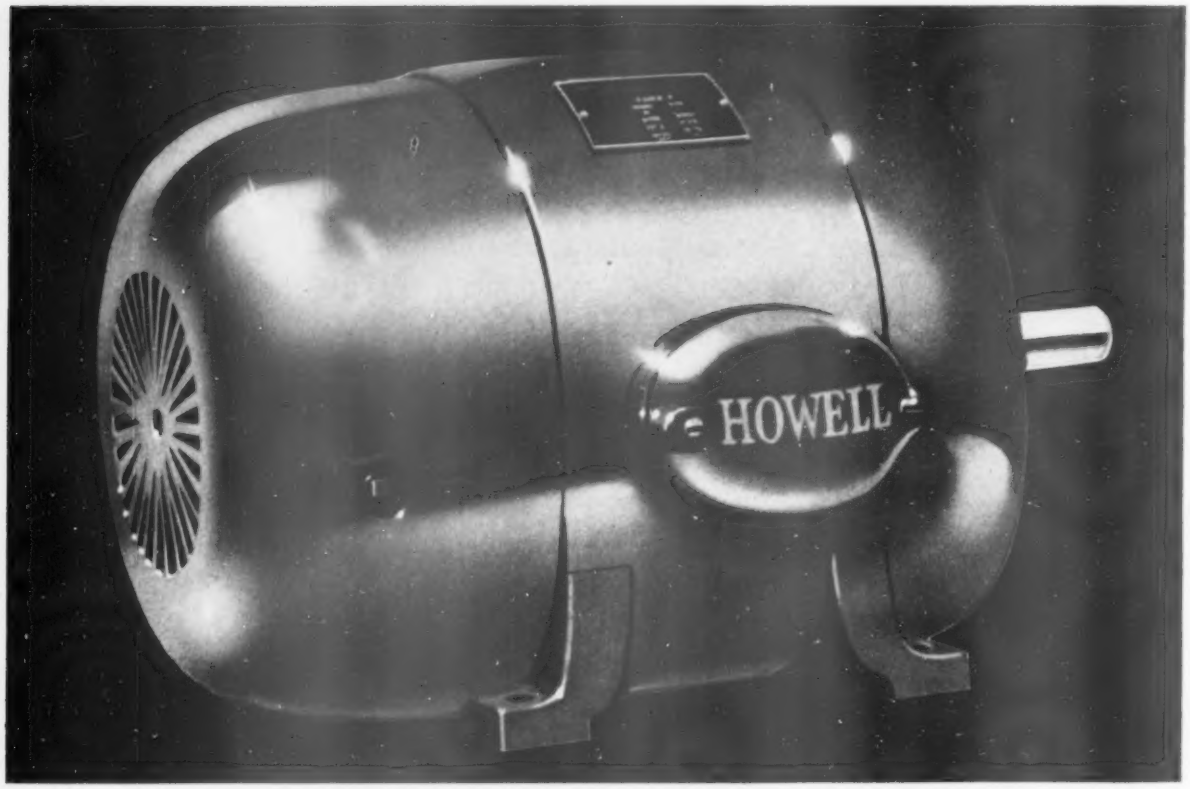


Chart 7.



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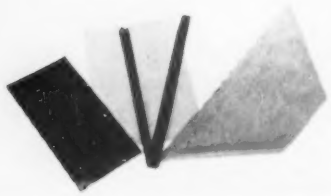

More and better insulation. Each slot cell has seven different pieces of insulation. Top and bottom coils and phase groups are insulated. Howell insulation is unsurpassed in quality.

Improved coil varnish. Type K stators are thoroughly impregnated twice with a phenolic, resin base varnish, and twice baked for unusual protection against moisture, dust, oil, weak acids and mild alkalies.

Howell Type K Motors outperform and outlast any open-type motor. Totally enclosed, all working parts are protected against the destructive action of dust, dirt, fumes and moisture. The fan-cooling prevents motor overheating.

The all-steel, streamlined housing conforms to the most modern trends in machine-tool design and factory layout.

Howell Type K Motors are available in all electrical types, from 1½ to 300 hp. at 1800 rpm., with vertical or horizontal mounting.

For more complete information on Howell's Type K Motors, contact the Howell man in your area, or write the factory for Bulletin K-2.

HOWELL Red Bond MOTORS

HOWELL MOTORS

HOWELL ELECTRIC MOTORS COMPANY, HOWELL, MICHIGAN

PRECISION-BUILT MOTORS FOR INDUSTRY SINCE 1915

QUESTIONS ON TECHNOLOGY

by W. L. Nelson
Technical Editor

This department was created for the purpose of aiding managers, superintendents, engineers, chemists, and all those engaged in various phases of plant operation, as well as those connected with the marketing and utilization of petroleum products. Readers are invited to submit their problems to W. L. Nelson, technical editor. Inquiries must be signed, but only the initials will be printed.

What are Figures on Isopentane Production?

What is the isopentane production of the United States and what is the potential amount of isopentane available in natural-gas and refinery liquids?" A.S.M.

Isopentane is available in such very large amounts that no one has bothered much with estimates of the potential production. Natural gasoline of Grade 26-70 (the basis of statistics) and cycle plant distillate has the following approximate composition:

	Per cent
Butane and lighter	32.0
n-Pentane	16.6
i-Pentane	18.7
Hexane and heavier	32.7

If the percentage of isopentane (18.7 per cent) is accepted, the barrels per day of isopentane available from natural gasoline and cycle plant gasoline, is:

	Natural gasoline, etc. B/D	Isopentane* B/D
1941	221,521	41,400
1945	306,861	57,400
1948	400,877	76,300
1949	430,373	80,500
1950	498,523	93,100
1951	563,046	105,300
1952	603,429	112,800
1953 (est.)	632,877	118,300

*Estimate

An estimate of the isopentane content of refinery gasolines (excluding natural gasoline) cannot be made with accuracy but the general magnitude of the isopentane (and isopentene) content is about the same (recently) as the natural-gasoline figures. Accordingly, the potential production during 1953 is expected to be about 240,000 bbl. per day.

These figures should not be confused with the very small actual production. The recovery and separation of isopentane are expensive because of the high degree of fractionation required and hence little of it is recovered. The Preliminary Report of the U. S. Tariff Commission (Synthetic Organic Chemicals, 1952) indicates that only 15,401,000 pounds of pentanes was separated in 1952. This corresponds to only about 192 bbl. per day. Undoubtedly this figure is only the mixed pentanes used as a base stock in petrochemical manufacture, and it does not include the isopentane that is utilized in aviation fuels.

How to Compute Coking Yields

"We see your answer of July 7, 1952, concerning yields when coking, but you leave out the amount of coke and of gas that is produced. We cannot easily compute these. Will you please show similar information including the coke and gas yields?"—F. W. S.

So many factors are involved in coking yields that it was not thought advisable to present such detailed data. However, Table 1 here, somewhat expands the yield information of the answer of July 7, 1952, page 103. The same method of computation as suggested therein was used in computing the coke and gas yields of Table 1.

TABLE 1—APPROXIMATE YIELDS FOR COMMON COKING OPERATIONS

	No gas oil			50% of 18° A.P.I. gas oil		
Feed,* A.P.I.	L.V.% gaso.	Gas,† ft.³/bbl.	Coke, tons/1,000 bbl.	L.V.% gaso.	Gas,† ft.³/bbl.	Coke, tons/1,000 bbl.
4	35.0	1,420	85.9	7.3	735	63.0
5	36.7	1,370	82.8	9.0	705	60.5
6	38.5	1,330	79.7	10.8	672	58.1
7	40.2	1,310	76.7	12.5	642	55.4
8	42.0	1,290	73.7	14.3	615	52.8
9	43.8	1,270	70.8	16.0	586	50.2
10	45.5	1,250	68.0	17.8	559	47.7
11	47.3	1,225	65.2	19.5	530	45.3
12	49.0	1,200	62.5	21.3	502	42.8
13	50.8	1,175	60.0	23.0	470	40.4
14	52.5	1,150	57.4	24.8	440	38.0
15	54.2	1,125	54.8	26.5	410	35.4
16	56.0	1,100	52.3	28.3	382	32.9
17	57.7	1,075	49.9	30.0	355	30.6
18	59.5	1,050	47.5	31.8	331	28.2
19	60.2	1,025	45.0			

	60% of 22° A.P.I. gas oil			70% of 26° A.P.I. gas oil		
Feed,* A.P.I.	L.V.% gaso.	Gas,† ft.³/bbl.	Coke, tons/1,000 bbl.	L.V.% gaso.	Gas,† ft.³/bbl.	Coke, tons/1,000 bbl.
6	1.6	735	54.1			
7	3.3	700	52.2			
8	5.1	667	49.3			
9	6.8	636	46.9			
10	8.6	605	44.5			
11	10.3	570	42.2			
12	12.1	537	39.8	1.7	565	39.6
13	13.8	505	37.5	3.4	524	37.6
14	15.6	475	35.1	5.2	482	35.6
15	17.3	444	32.8	6.9	449	33.1
16	19.1	412	30.4	8.7	417	30.7
17	20.8	380	28.3	10.4	386	28.5
18	22.6	350	26.0	12.2	356	26.3
19	24.3	320	23.7	13.9	325	24.0
20	26.1	289	21.3	15.7	294	21.7
21	28.6	258	19.0	17.4	263	19.4
22				19.2	232	17.2
23				20.9	200	15.0

*Residual stocks. †Wet gas of 28 molecular weight.

in This Bank

Friendly, personal know-how is traditional with the Republic Staff . . . another reason why oil men in every oil-producing area in America refer to Republic as "The Oil Bank."

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How to Design and Evaluate Absorbers—12

by R. J. Hull and K. Raymond

CONTINUING with the example of absorber performance calculation which was begun in Installment 11:

6. Compute first trial shrinkage using eight theoretical trays and scaling temperatures from T_{B0} to T_{AV}. See calculation tabulation on Table 3. Calculated shrinkage is close enough to proceed with more detailed calculations.

7. Now, $V_{B0} = 6{,}500 - S = 6{,}500 - 889 = 5{,}611$ M.c.f. per day. Compute mole fractions of components in top section liquid. Use actual discharge gas temperature, 78° F., to obtain component equilibrium constants.

Authors are with California Research Corp., Richmond, Calif. Paper presented at California Natural Gasoline Association meeting, Los Angeles.

$$x_i = \frac{y_{i0} \times (V_{i0} - V_{iD}) \times (1-F) \times K_{iB}}{79.0} + \frac{FL \times_{i0} K_{iB} V_{iD} A}{(14.4)(5{,}611)(0.033)} = x_i' + x_i'' = x_i$$

Air	$\frac{(0.0618)(6500/5611)(1-0.007)}{79.0}$		= 0.0009	= 0.0009
C_1	$\frac{(0.5436)(1.158)(1-0.033)}{14.4}$	$\frac{(0.033)(1)}{(14.4)(5{,}611)(0.033)}$	= 0.0423	= 0.0423
C_2	$\frac{(0.2665)(1.158)(1-0.216)}{2.20}$	$\frac{(0.216)(29)}{(2.20)(5{,}611)(0.216)}$	= 0.1100 + 0.0023	= 0.1123
C_3	$\frac{(0.1281)(1.158)(1-0.636)}{0.68}$	$\frac{(0.636)(106)}{(0.68)(5{,}611)(0.644)}$	= 0.0794 + 0.0274	= 0.1068
				0.2623

where:

x_i' is mole fraction of component absorbed in top section.

x_i'' is mole fraction due to presence of component in lean oil.

x_i is total mole fraction of component in top section.

Table 3—Sample Absorber Performance Evaluation Calculation

FIRST SHRINKAGE TRIAL

	$y_{i0}V_{i0}$ M.c.f./day	T_0, °F.	K 245 psia.	$A = (L/V)_{BOM} \times 1/K$	F 8 theo. trays	Lx_{i0}/A	$(y_{i0}V_{i0} - Lx_{i0}/A)$ M.c.f./day	S* M.c.f./day
Air	402	84	74.0	0.007	0.007		402	3
C_1	3,533	84	15.0 × 1.025	0.033	0.033	30	3,503	116
C_2	1,732	87	2.35	0.216	0.216	134	1,598	345
C_3	833	91	0.79	0.644	0.636	164	669	425
	6,500							889

SECOND SHRINKAGE TRIAL

	$y_{i0}V_{i0}$ M.c.f./day	T_0, °F.	K 245 psia.	(L/V)	A_E	F	T_0, °F.	K 245 psia.	(L/V)	A_C	Lx_{i0}/A_C	$(y_{i0}V_{i0} - Lx_{i0}/A_C)$ M.c.f./D.	S† M.c.f./D.
Air	402	84	74.0	0.520	0.007	0.007	84	74.0	0.520	0.007		402	3
C_1	3,533	84	15.0 × 1.025	0.520	0.034	0.034	84	15.0 × 1.025	0.522	0.034	29	3,504	119
C_2	1,732	87	2.35	0.525	0.223	0.223	82	2.25	0.532	0.236	123	1,609	359
C_3	833	91	0.79	0.533	0.675	0.665	80	0.70	0.548	0.784	135	698	464
	6,500												945

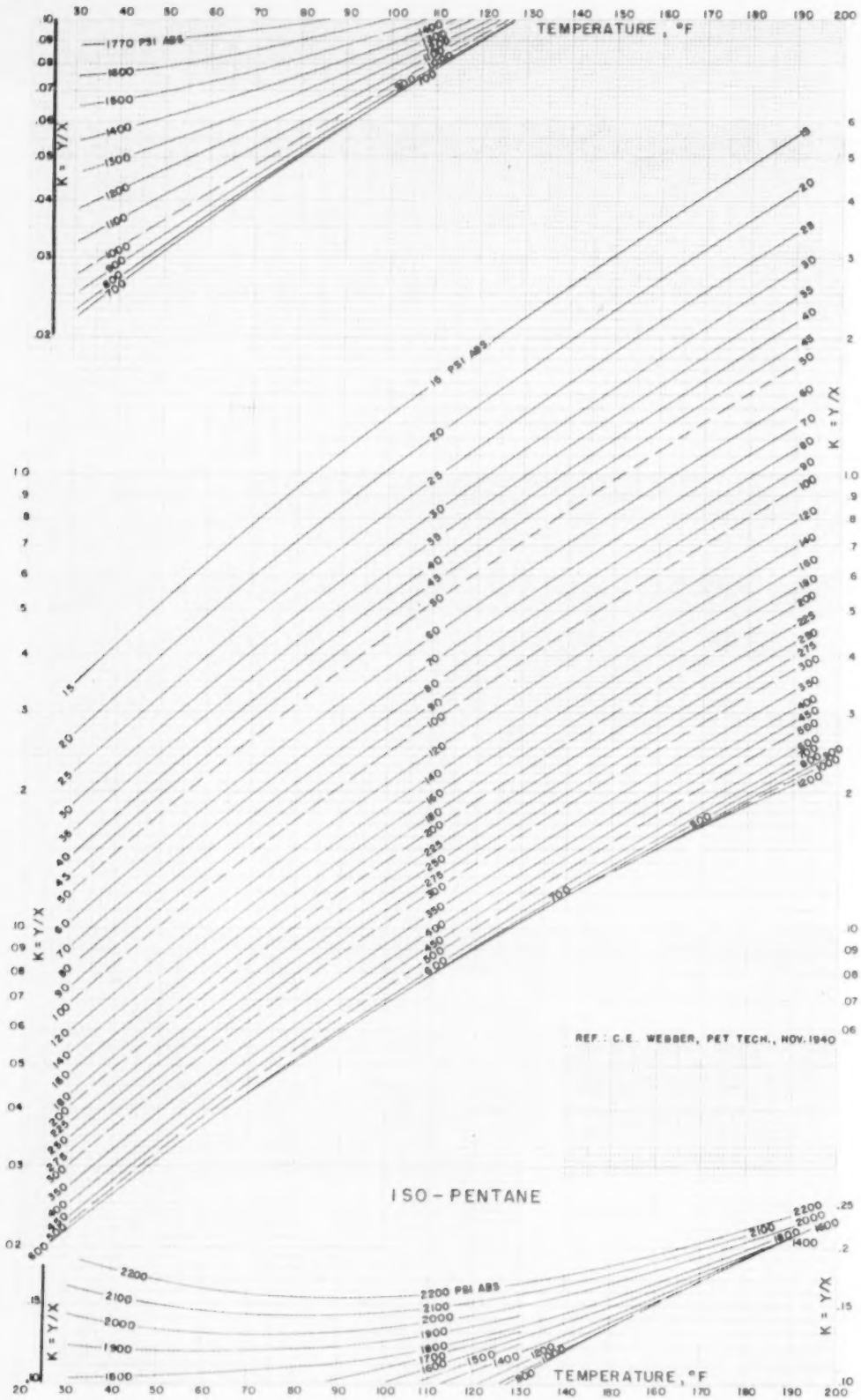
FINAL CALCULATION

	$y_{i0}V_{i0}$ M.c.f./day	T_0, °F.	K 245 psia.	(L/V)	A_E	F	T_0, °F.	K 245 psia.	(L/V)	A_C	Lx_{i0}/A_C	$(y_{i0}V_{i0} - Lx_{i0}/A_C)$	S‡ M.c.f./D.
Air	402	84	74.0	0.517	0.007	0.007	84	74.0	0.517	0.007		402	3
C_1	3,533	84	15.0 × 1.025	0.517	0.034	0.034	84	15.0 × 1.025	0.518	0.034	29	3,504	119
C_2	1,732	88	2.37	0.523	0.221	0.221	82	2.25	0.529	0.235	123	1,609	356
C_3	833	94	0.815	0.531	0.651	0.644	80	0.70	0.548	0.783	135	698	450
	6,500												928

COMPONENT RECOVERIES BASED ON INTAKE AND DISCHARGE GAS ANALYSES

	Intake gas: Vap. % $y_{i0} \times 100$	Intake gas: M.c.f./day $y_{i0}V_{i0}$	Discharge gas: Vap. % $y_{iD} \times 100$	Discharge gas: M.c.f./day $y_{iD}V_{iD}$	Shrinkage M.c.f./day $y_{i0}V_{i0} - y_{iD}V_{iD}$	Actual per cent recovery $(y_{i0}V_{i0} - y_{iD}V_{iD})/y_{i0}V_{i0}$	Calculated per cent recovery (from final calculation) S/$y_{i0}V_{i0}$
Air	6.18	402	6.66	371	31	7.7	§0.7
C_1	54.36	3,533	61.25	3,413	120	3.4	3.4
C_2	26.65	1,732	25.08	1,397	335	19.3	20.6
C_3	12.81	833	7.01	391	442	53.1	54.0
	100.00	6,500	100.00	5,572	928		

*$S = F(y_{i0}V_{i0} - Lx_{i0}/A)$. †$S = F(y_{i0}V_{i0} - Lx_{i0}/A_E)$. ‡$S = F(y_{i0}V_{i0} - Lx_{i0}/A_C)$.
§See Step 14 in text, in later installment.



Equilibrium constants for isopentane. Reference: C. E. Webber, Pet. Tech.; November 1940.

3. Electronic Gating Knockmeter . . .

for combustion studies in full-scale engines

by M. M. Adams

THE integrating channel of the electronic gating knockmeter is composed of both stages of V-7 and associated circuitry. Section 1 of V-7 is normally held far below cutoff until the gate pulse is registered in the signal output. This high amplitude pedestal with the superimposed a.c. signal upon it drives section 1 of V-7 as a pulsed cathode follower. The peak voltages are averaged in a long-time constant circuit, and this average voltage is applied to the second section of V-7 to drive the meter movement from the cathode circuit. The meter is a 4½-in., 0 to 100-μa. instrument and has an additional 20,000 ohms placed in series with it to prevent damage in case of sudden voltage surges. The "Threshold" control, available inside the cabinet, offers a means of changing sensitivity of the instrument when used in conjunction with the "Zero" control, available on the front panel. In cases where extreme sensitivity is required, the instrument may be operated at a depressed zero to overcome certain limitations. Linearity of this integrating arrangement has been checked by a plot of input signal versus meter readings and found to be highly satisfactory.

Specialized Uses

In addition to utilizing this instrument in routine automotive testing, limited experience has indicated that other research programs can be greatly aided by utilization of this device. Several of the experiments made possible through use of this instrument are described here.

1. Using a crystal microphone as a transducer and gating on the audible signal emanating from the crank case door on a research method engine, a plot of constant, audible knock intensity versus micrometer settings was made from the 80-octane level to the 148-performance level. Tests were conducted on two different engines with results, in both cases, in almost perfect coincidence with the High Octane Reproducibility Study Group guide curve. From time to time during these tests, in an effort to determine if the microphone had slipped from its original position, attempts were made to reproduce micrometer settings using the level indicated on the Electronic Gating Knockmeter scale. Using only this indication it was possible to "blindly" return the micrometer readings to within .003 in. of the original setting. Spread used during this test was approximately 12 divisions per octane number at the 90-octane level.

2. During work connected with sound-wave observations, it was observed that the output of an internal type pickup varied in an erratic manner with respect to crankshaft angle when autoignition or preignition was occurring. In this test, the gate width was set to represent about 5° of crankshaft rotation and the peak output of the D-1 pickup superimposed on the gate center. Preignition and autoignition manifest themselves by erratic and immediately obvious movements toward the leading edge of the gate. Ordinary dp/dt pickup phase eccentricities from cycle to cycle are much smaller in amplitude than those which are apparent when preignition and autoignition are present. Proper calibration of gate width, with due regard to normal phase eccentricities, makes this a useful means of identifying incipient autoignition and preignition.

3. In a number of basic studies on engine operation, it is advantageous to determine the principal frequencies present in the transducer output. Superposition of these signals on a gate of convenient time width greatly simplifies identification of the frequency of the principal component.

4. At certain times it is desirable to make a comparison of power outputs, using various fuels, or with the same fuel under various engine conditions. Quite often a dynamometer of proper size and capacity is not available. Use of the calibrated gate in conjunction with a reliable pressure pickup affords a means of plotting a pressure-versus-crank angle curve from which power ratings may be obtained.

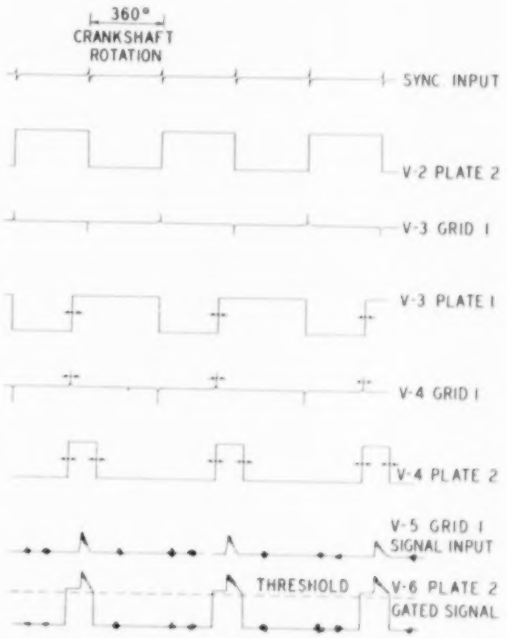


Fig. 1—Time sequence of wave forms during complete engine cycles.

Author is manager of instruments division, Phillips Petroleum Co., Bartlesville, Okla.

Carrier Centrifugal Compressors

on the job at

Shell Oil Company

These are two of the three Carrier Centrifugal Compressors on the job at Shell's Deer Park, Texas, refinery. Five more Carrier Compressors have been installed in Shell refineries.

Carrier makes a complete line of centrifugals for gas compression and refrigeration—up to 10,000 hp in a single unit. There are hundreds of these dependable, efficient Carrier machines on the job at dozens of refineries across the country—serving such companies as The Atlantic Refining Co., Cities Service Co., Esso Standard Oil Co., Humble Oil & Refining Co., Sinclair Oil Corp., The Texas Co. May we assist *you?*

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Applying Lube-Oil Additives—4

by W. D. Thomas

THE American Petroleum Institute has now reclassified motor oils according to service requirements. It is intended that three grades be available for spark ignition engines including light, moderate, and severe types of service. Two grades are to be available for diesel equipment, one for service where operating conditions are good and one for severe-duty service.

Test methods are required for the development of new and improved products and for quality control.

From the A. P. I. definitions of services for spark-ignition engines it is conceivable that a well-refined quality oil would meet the light service requirements. For moderate service it is believed that an inhibited oil will give satisfactory service. The standard L-4 engine test for determining the oxidation characteristics of an oil can be used as a guide. Severe service includes not only high-temperature and high-load operation but also start-and-stop operation. Tests for measuring quality for the high-temperature operation are available. A method for measuring the performance of an oil under start-and-stop conditions has not yet been standarized although many laboratories are actively engaged in developing a satisfactory means.

Cycling tests intended to stimulate actual service appear to be the closest approach to date. A tool of this nature would greatly accelerate the development of new and improved additives for this type of service.

In the past 25 years we have seen considerable progress made in the formulation of motor oils to meet the required demands imposed by improved engine designs, fuels, and operating conditions. The satisfactory performance of the finished product is dependent upon the selection of the crude, the method of refining, and finally the selection of additives to impart the properties necessary for specific application.

Of our present-day problems cold-weather sludge arising from start-and-stop operation is foremost. A means of evaluating oils in the laboratory for this service would greatly accelerate the development of more efficient lower-cost additives. In regard to the problem of combustion-zone deposits we cannot preclude the possibility of its solution by the use of the proper lubricant, but at the present it appears that the selection of the base oil will be more important than the additives.

Author is with American Cyanamid Co. From paper presented at W. P. R. A. meeting.

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3. "Series II Oils Pay Their Way," W. C. Brown, F. A. M. Buck, J. A. Edgar, F. E. Kronenberg, and J. M. Plantfever, S. A. E. annual meeting, January 8-12, 1951.

Comments on "Applying Lube-Oil Additives"

By V. A. Kalichevsky

THE paper raises several problems which are of interest in formulations of additive motor and diesel oils and in refining of base stocks.

Compatibility of additives is an important consideration in the preparation of improved products. Up to the present time, little information was published on this subject and the refiner has to rely on empirical methods in selecting the additives. This is an expensive and a time-consuming procedure discouraging commercial development of new products.

Detergents are defined by the author as additives which maintain engine cleanliness "by virtue of their dispersing action." If this were their only function the use of metals could be avoided and the presence of ash-forming constituents eliminated. Detergents now in use contain metals. Commercial oils may have not only calcium or barium but other metals like magnesium or zinc as their substitutes. The nature of the metal might have little direct influence on the detergent action or the formation of carbon deposits in the hot portion of the engine. Ash might have a detergent effect by changing physical characteristics of the carbon deposits. Selection of the organic radical for an unifunctional detergent may be guided by similar considerations. The wide range in the concentration of detergents, from 1 to 15 per cent, might be explained not only by the desire to improve the oil performance but also by the variations in the efficiency of commercial detergents.

The author states that "cycling tests intended to simulate actual service appear to be the closest approach to date." It is difficult to visualize that a single test can be devoted which could be correlated with the fluctuating conditions of service. Driving habits and driving conditions vary widely and an "average" driver is just as uncommon as "averages" in nature. Cyclic tests involve a larger number of variables than the conventional tests and are more difficult to reproduce. Even if the reproducibility were the same, their interpretation in terms of single variables is hampered. Under any conditions the cyclic tests can reproduce only a single modification of the many possible combinations of service variables. The uncertainty of interpreting the results is increased and not reduced.

The statement that "at present it appears that the selection of the base oil will be more important than the additives" implies that the oil quality has the greatest influence in the performance of additive oils and not the additives. The available information shows that no straight mineral oil has yet been developed which would give the same performance as the additive oils. This makes selection of additives of primary importance in oil formulations. The oil is normally refined to adjust its additive response. The highly refined oils have usually a better additive response than the moderately refined oils but their engine stability in the absence of additives is in the reverse order. The additive and not the oil thus becomes again of primary consideration in the manufacture of high-grade products.

EQUIPMENT MEN . . . in the News

Harrington Is Leschen's Assistant General Manager

HARRINGTON

The appointment of H. A. Harrington to the newly created position of assistant general manager, Leschen Wire Rope Division, H. K. Porter Co., Inc., St. Louis, has been announced by D. W. Vernon, vice president and general manager of Leschen.

Harrington, who has served the Porter organization in various capacities, will assist in the over-all management of the division. Most recently he was special assistant to Porter's executive vice president. His background includes positions as general manager of Porter's spring division, and vice president of Good Roads Machinery Co., of New York.

Welex Promotes Avent to Operations Manager

O. B. Avent, former Ardmore, Okla., district manager for Welex Jet Services, Inc., has been promoted to the position of operations manager of Welex, the Fort Worth oil-well servicing firm has announced.

Avent's promotion caps 20 years of experience in the oil business, 13 of which have been spent with Welex and Lane-Wells. Seven years of work with other well-known firms in the industry, such as Pacific Pump, Western Acid, and Oil Well Supply Co., have given him broad experience in service operations.

Brown & Root, Inc., Makes Mundy a Vice President

A. J. MUNDY, JR.

A. J. Mundy, Jr., has been made a vice president of Brown & Root, Inc., Houston, according to an announcement by Herman Brown, president.

Mundy, a graduate of Georgia School of Technology, has been with the Houston engineering and construction firm since 1946, and was a division manager in charge of Brown & Root's Canadian operations at the time of his promotion. He also had over-all supervision for Brown & Root of the Lone Star Steel Co.'s expansion program in Texas.

Mundy went with Robert & Co., of Atlanta, following his graduation in 1929, and was with this company in various types of engineering work until 1942. He was also at one time with Kaiser Corp., of California, as construction engineer, and had 3 years' experience as a private consulting engineer at Atlanta.

Upon joining Brown & Root, Inc., in 1946, he was put in charge of design and construction for paving, utility systems, and industrial work in the Houston area.

Winslow Filters on Trans Mountain Line

One of the most complete filter systems designed for any pipe-line pumping system has been installed on the 718-mile Trans Mountain pipe line, which will carry crude oil from western Canadian fields to refineries on the Pacific Coast. The system of fuel filtration to be used on the line was developed by Winslow Engineering Co., of Oakland, Calif., to burn crude oil of varying specifications in standard-model diesel engines.

Winslow crude filters have been installed at Edson, Black Pool, and Kamloops stations. The filter system is a series of jacketed Winslow filters of increasing density with elements treated for removal of moisture and solid particles and the neutralizing of dissolved sulfur compounds.

One of the Winslow filter installations on Trans Mountain pipe-line pumping system. The filtered crude is used for fuel in the Nordberg pumping engines.

The Trans Mountain system is based on similar Winslow pipe-line installations, by which satisfactory fuel is supplied pumping engines. Winslow full-flow lubricating-oil filters are also installed on all the main Nordberg pumping engines.

National Makes Herndon Production Sales Manager

Thomas B. Herndon has been appointed sales manager, production equipment, according to an announcement made by National Supply Co., Pittsburgh

Herndon joined the company in 1936 as a student engineer at Rodessa, La. After 3 years as a field engineer in a number of the company's oil-field stores, he was transferred to the export division in New York.

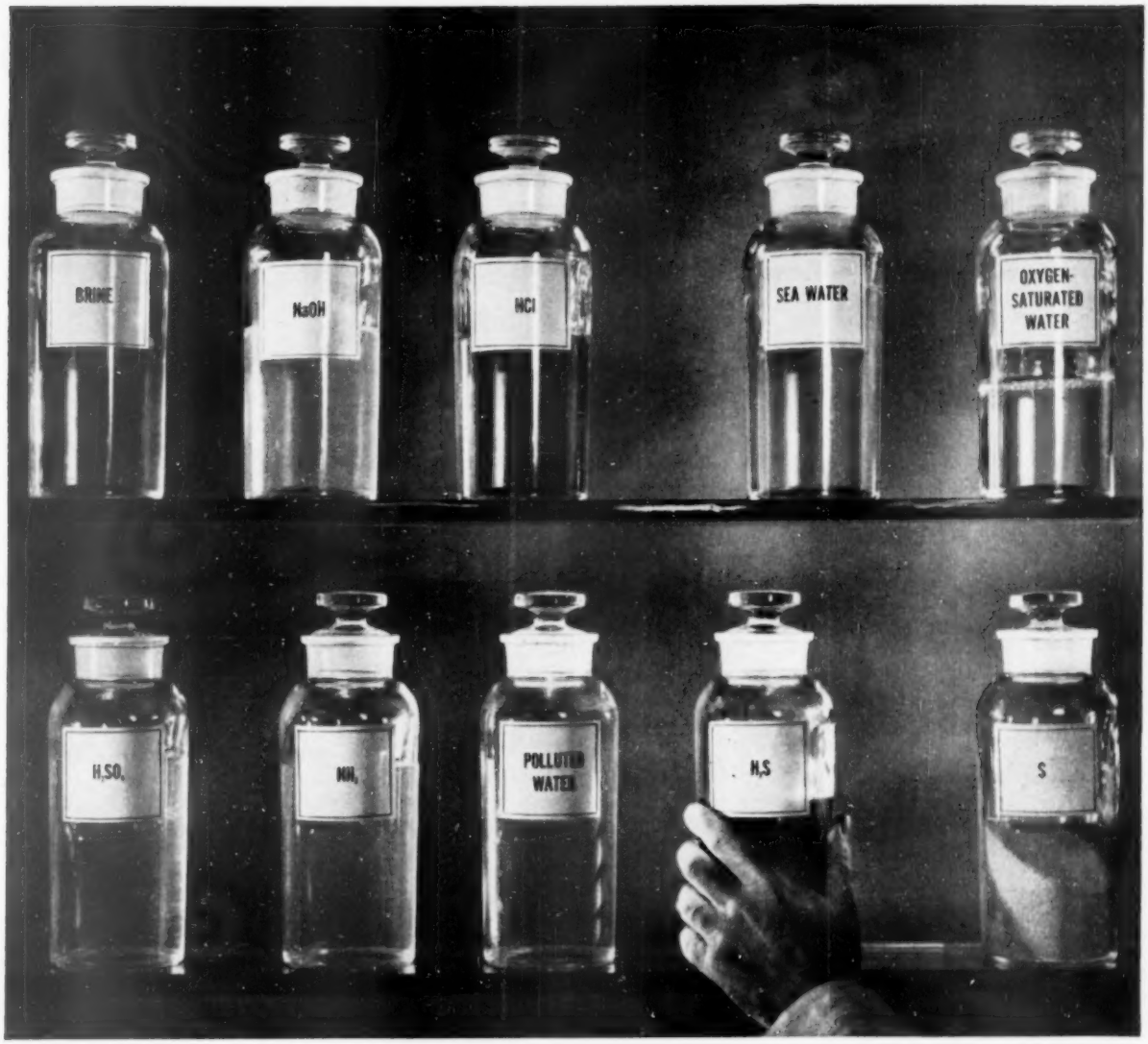
From 1940 to 1950 he was engaged in sales and engineering work in Trinidad and Caracas, Venezuela, rising to the position of division manager in Caracas for National Supply Co. of Venezuela, C. A.

In 1950 Herndon returned to the United States as development engineer for the company's general engineering department. He is a 1935 graduate mechanical engineer of Rice Institute.

Advertising Man Completes Petroleum Course

Lionel Ormsby, account executive with Dozier-Eastman & Co., industrial advertising agency, Los Angeles, has completed an engineering course in petroleum refining, given through the facilities of University of California extension division.

The scope of the course covered equipment and processes used in the refinery to convert crude oil into fin-



Maybe we can "bottle up" your tube problem, too

THESE ARE some of the corrosives that commonly must be dealt with in refinery operations—and that present the problems connected with selecting the most suitable heat exchanger tube alloy.

Experience indicates that there is no one tube alloy that will give better service than all others under all operating conditions. But it is possible to select the material which will give the most efficient and economical service under any specific operating condition.

It is especially practical to do so from the wide range of ANACONDA Copper and Copper Alloy Tubes by drawing upon our Technical Department's scientific and practical knowledge, accumulated during more than a century of experience in manufacturing brass and copper products. The coupon will bring you a booklet of helpful basic information on this subject—or write to our Technical Department.

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Heat Exchanger Tubes

Ambraloy-927; Arsenical Admiralty-439; Cupro Nickel, 30%-702; and other copper alloys*

**U. S. Patent No. 2,003,685 (ORIG.)*

The American Brass Company, Waterbury 20, Conn.
(In Canada: Anaconda American Brass Ltd., New Toronto, Ont.)

Send me Publication B-2 "Anaconda Tubes and Plates for Condensers and Heat Exchangers"

NAME .....

COMPANY .....

STREET .....

CITY ..... ZONE ..... STATE .....

ished products. Included were studies of petroleum chemistry, types of crude oils, distillation, cracking, and the conversion processes-polymerization, alkylation, and reforming; treating and blending of gasoline, plus the basic instrumentation used to measure the composition of hydrocarbons.

Now in its thirtieth year, Dozier-Eastman & Co. has been serving firms in southern California, which manufacture equipment for all phases of the petroleum industry, for exploration, drilling, producing, transporting, and refining of petroleum and natural gas. Ormsby has been with the agency 8 years.

Southwest Steel to Make Aluminum, Copper Vessels

Southwest Steel Corp. of Tulsa, recently purchased by Kelly F. McCann and Jasper P. Cox, Jr., is expanding its operations to include aluminum and copper-alloy pressure vessels for the chemical industry. McCann and Cox, who were formerly associated with Warner Lewis Co., purchased the steel plant from M. J. McNulty, Jr., pioneer Tulsa industrialist. The company has been manufacturing and fabricating oilfield equipment and supplies.

Prior to being associated with Warner Lewis, McCann, the new president of the steel company, was with Moorlane Co., and Cox, vice president of the steel company, was with Phillips Petroleum Co. The steel plant was established in Tulsa in 1951, and has served the national oil industry.

OPW Appoints Clements As District Manager

L. J. CLEMENTS

Luke J. Clements has been appointed district manager, operating out of St. Louis, where a new regional office has been established by OPW Corp., of Cincinnati. OPW manufactures valves, fittings, and assemblies for handling hazardous liquids.

Clements has been with OPW since 1951, in the capacity of sales engineer. His new duties will be in the supervision and coordination of the activities of manufacturers, agents, and jobbers in Missouri, Kansas, and western Tennessee area.

4429

Strom STEEL BALL CO.
Largest Independent and Exclusive Metal Ball Manufacturer
1850 South 54th Avenue, Cicero 50, Illinois
Pacific Coast Representative: R. J. SCHENK, 716 South Main Street, Santa Ana, Cal.
Southwestern Representative: E. E. GRAHAM & CO., 3902 Navigation Blvd., Houston 3, Texas

M-H Appoints 16 to Sales Staff Positions

Sixteen sales engineers were recently added to the field sales force of Minneapolis-Honeywell Regulator Co.'s industrial division in 13 branch offices, located in 11 United States cities and 2 Canadian cities, it was announced by J. A. Robinson, field sales manager.

Robinson said the appointments were in line with the division's planned growth program designed to meet expanded industrial demand for instruments. He pointed out that investments for such equipment made by industry as capital outlays has increased more than eight times over the prewar rate, spreading over more than one-half of the 304,000 manufacturing firms in the country.

At the same time Robinson reported that 20 service engineers were also added to the firm's field sales force taking assignments in 17 United States cities and 2 Canadian cities.

The new appointees, all graduates from the company's industrial instrument training school in Philadelphia, include: K. J. Lesker, Dallas; O. E. Krienke, New Jersey; W. J. Boschert, St. Louis; W. G. Henderson, Chicago; R. P. Norton, Indianapolis; W. J. Young, Houston; W. C. Curp, Dayton; W. T. Lisenby and J. T. Gentry, Los Angeles; J. L. Ciprari, Minneapolis; K. Batchelor, Houston; W. L. Bolton, Atlanta, R. J. Raycroft, Toronto; T. M. Hunt and W. F. Harrison, Montreal; and H. E. Allison, International Division.

Republic Names Hughes to Manage Distributor Sales

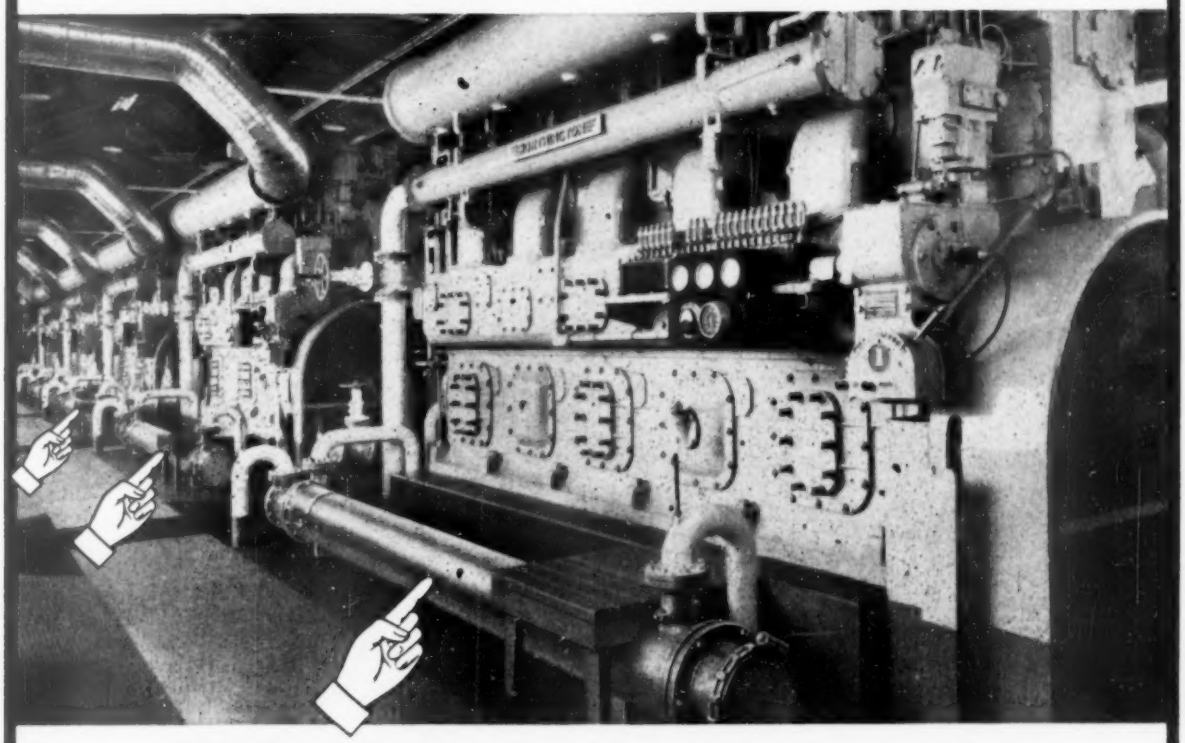
J. M. HUGHES

James M. Hughes has been appointed manager, distributor sales for Republic Rubber Division, Lee Rubber & Tire Corp., Youngstown, Ohio.

In announcing the appointment, E. M. Ikirt, Republic's general manager, stated that Hughes would work closely with Republic distributors to assist them to secure a larger share of the rapidly expanding market for industrial rubber products.

Since 1949 Hughes has been sales development manager at Republic, in charge of advertising, sales promotion, and sales training. He will continue to direct these activities. His entire

cooling the lube oil for 10 Worthington Compressors on this 423-mile gas pipeline



...ROSS EXCHANGERS

Moving 167,000,000 cu. ft. of gas per day through a 423-mile, 24-inch line is the job assigned El Paso Natural Gas Company's Navajo Station. Carrying the load are 10 Worthington Uniflo UTC-165 Gas Engine-Compressors with a combined rating of 7900 hp at this elevation of 6800 ft.

In virtually continuous operation — bearings, valve gear, pistons, power and compressor cylinders must receive constantly an ample supply of properly cooled lube oil. *And they do!* Each of the Worthington units is served by a Ross Type CP Exchanger. Safe, dependable cooling is assured at all times.

Top-rated for both thermal efficiency and ruggedness, Ross Exchangers work side-by-side with numerous types and makes of prime equipment in the oil and gas industry . . . in fact, in *every industry* . . . to cool lube oil, jacket water and hydraulic fluid.

Pre-engineered and fully standardized Ross Type CP Exchangers are assembled from mass produced parts and sub-assemblies to fulfill individual requirements — *promptly*.

More information is in Bulletin 2.1K1. Write.

KEWANEE-ROSS CORPORATION

DIVISION OF AMERICAN RADIATOR & STANDARD SANITARY CORPORATION

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In Canada: Kewanee-Ross of Canada Limited, Toronto 5, Ont.

Serving home and industry: AMERICAN STANDARD • AMERICAN BLOWER • CHURCH SEATS & WALL TILE • DETROIT CONTROLS • KEWANEE BOILERS • ROSS EXCHANGERS • SUNBEAM AIR CONDITIONERS

Catawissa
PERFECT SEAL
Unions

HOT FORGED from solid, rectangular steel bars, designed and produced for dependable, long-life service under the severest piping conditions!

A TYPE FOR EVERY USE!
FOR ALL PRESSURES!
FOR ALL TEMPERATURES!

Standard & Double Extra Heavy
UNIONS
Available with screwed or socket weld ends. 3000-lb. sizes ⅛" to 3"; 6000-lb. sizes ⅛" to 2".

ORIFICE UNIONS
With screwed or socket weld ends. 3000-lb. and 6000-lb. service.

MALE & FEMALE UNIONS
With steel-to-steel, bronze-to-steel, stainless steel-to-steel or orifice seats. 3000-lb. service only.

Standard & Double Extra Heavy
LUG NUT UNIONS
Hammer-type for quick opening and quick closing.

Write for your free copy of catalog 11 for complete information

CATAWISSA VALVE AND FITTINGS COMPANY
450 Mill St. • CATAWISSA, PA.

business career has been in the rubber industry. After graduating from Michigan State College in 1936, he spent 11 years in various operating and sales positions with Goodyear Tire & Rubber Co. He was assistant sales manager of Pennsylvania Rubber Co. immediately prior to joining Republic.

He worked with Sinclair Oil & Gas Co., in Tulsa, and with Bennett Brothers Oil Co., Fort Worth, before joining Nelson in 1950.

The Nelson firm, now in its sixteenth year of operation, manufactures electrical equipment, including explosion-proof motor controls, junction boxes and enclosures, circuit breakers, lighting panels, oil-field motor controls, automatic pipe-line sampling devices, cathodic-protection equipment, instrument and control panels, and unit substations.

Nelson Names Sulton As Area Manager

JOHN SULTON

John Sulton, Jr., has been named sales manager over Oklahoma and the Texas Panhandle for Nelson Electric Manufacturing Co., of Tulsa, it was announced recently by R. S. Terhune, Nelson general sales manager.

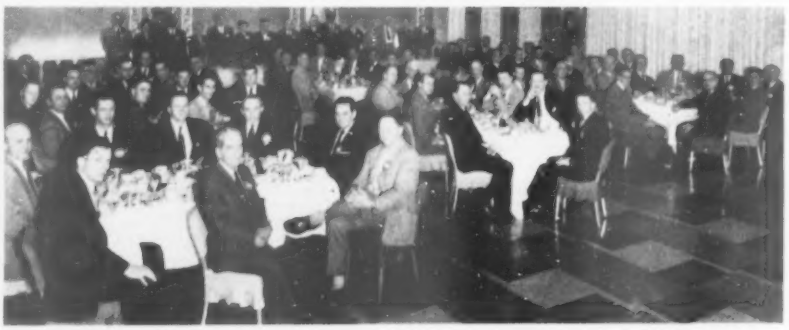
Terhune said Sulton will continue to service his regular accounts, and his new duties will include supervision of all Nelson salesmen in Tulsa and Oklahoma City.

Stone & Webster Executive Completes World Tour

Ralph D. Waterman, vice president of Stone & Webster Engineering Corp., Boston, has just returned from a 3-month trip around the world to inspect company projects, including four huge refineries scattered from England to Australia.

Waterman visited Britain, Italy, Kuwait, Bahrain, India, Burma, Thailand, the Philippines, Malay, Java, and Australia, before flying to Honolulu on his way home via San Francisco.

Bovaird Supply Managers Hold Annual Meeting



Bovaird's district and store managers met with company executives and department heads at the annual sales meeting in Tulsa.

A note of optimism and confidence in the future and recognition of a group of employes just completing 15, 20, and 25 years' service with the company, were highlights of Bovaird Supply Co.'s annual meeting held in Tulsa.

D. D. Bovaird presented the veteran employes of the company with their service awards. For 15 years' service, clock radios were presented to C. E. Pearson, Salem, Ill., Illinois district manager; J. E. Goodell, Great Bend, Kans., store manager; and Mrs. Jewell Myer, Tulsa. For 20 years' service, a silverplate coffee service went to E. R. Chastain, Chase, Kans., store manager. A wrist watch for 25 years' service went to the Robbins brothers, F. J. Robbins, Oklahoma City, Oklahoma district manager; and R. W. Robbins, Great Bend, Kans., Kansas district manager.

Attending the meeting were 5 district managers and 17 store managers, in addition to company officials, many department heads, salesmen, and others. The company's 22 stores and offices in Illinois, Oklahoma, Kansas, Texas, and New Mexico were represented. Engineers and sales executives of many leading oil-field machinery and supply manufacturers participated in the program in discussing new developments in field methods and equipment. The sessions were presided over by Roscoe G. Ayers, vice president and general manager of sales.

WHY MORE AND MORE OIL MEN COME TO THE SECOND NATIONAL BANK OF HOUSTON FOR COMPLETE BANKING SERVICE

Every year it is our pleasure at the Second National Bank of Houston to welcome more and more oil men as regular customers. Why?

Because Second National is an oil-minded bank. *Because* our Oil and Gas Division is staffed by engineers and geologists of wide practical experience in all phases of petroleum and gas development. And *because* oil men find at Second National all the elements of a thoroughly satisfactory banking relationship.

It will pay you to investigate the special advantages available to oil and gas companies and operators at Second National.

At the Hub of World Oil Activity

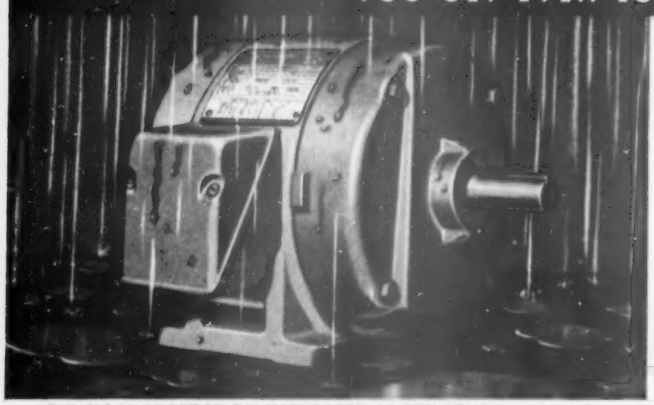
The SECOND NATIONAL BANK OF HOUSTON

MAIN AT RUSK

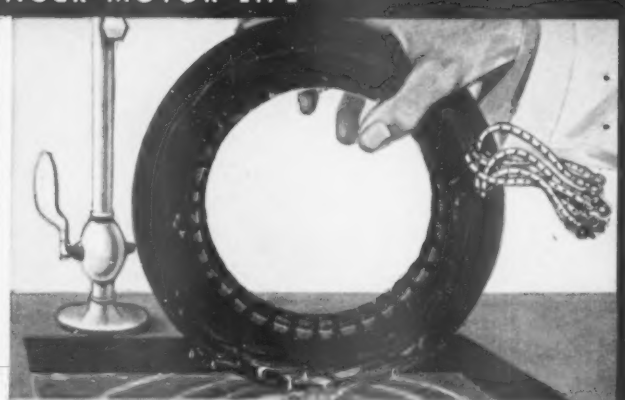
CAPITAL AND SURPLUS 15 MILLION DOLLARS

Member Federal Deposit Insurance Corporation

YOU GET EVEN LONGER MOTOR LIFE



PHYSICAL PROTECTION INCREASED 60 PER-CENT by a complete redesign of cast-iron frame and end shields. This motor is suitable for many jobs where ordinary dripproof motors should not be applied.



EXTRA ELECTRICAL STRENGTH is assured by use of new polyester film insulation. A silicone coating, Dri-film,* virtually eliminates stator insulation failure caused by moisture.

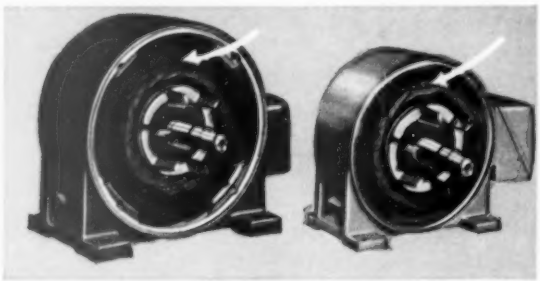
*REG. U.S. PAT. OFF.

TRI 55 CLAD REG U S PAT OFF THE LEADER IN MODERN MOTOR DESIGN

GENERAL ELECTRIC ANNOUNCES...

THE ALL-NEW TRI 55 CLAD MOTOR

REG U.S. PAT OFF



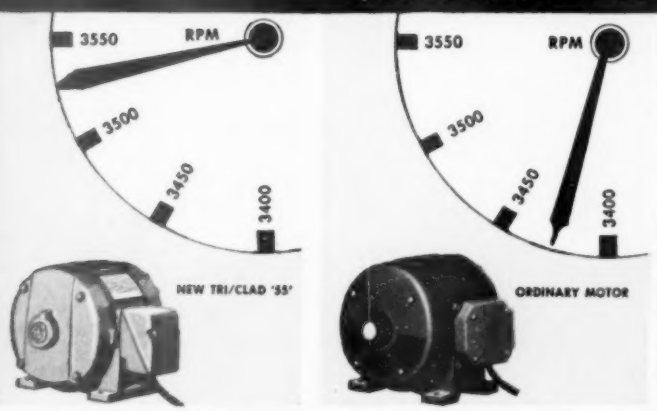
LIGHTER, SMALLER Tri/Clad '55' motors have been made possible through better use of space within the frame. Active materials (magnetic steel, copper) have not been sacrificed.

Complete Line of Dripproof, Enclosed Motors and Gear-Motors Available in Most Ratings in 1954

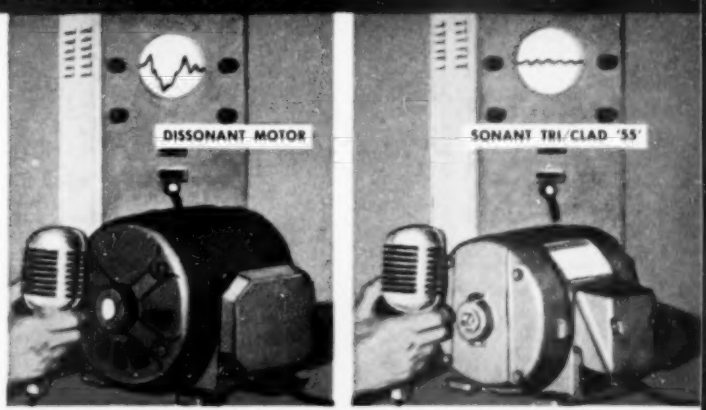
Here's the all-new Tri/Clad '55' motor — now available in NEMA 182 and 184 frame sizes.

You can get complete information on this dramatic motor achievement by writing for bulletin GEA-6013 on Tri/Clad '55' Dripproof motors, GEA-6012 on Tri/Clad '55' Enclosed motors, or GEA-6027 on Tri/Clad '55' Gear-motors, or by contacting your nearby G-E Apparatus Sales Office or G-E Motor Agent. General Electric Company, Section 648-1, Schenectady 5, N. Y.

YOU GET EVEN BETTER PERFORMANCE



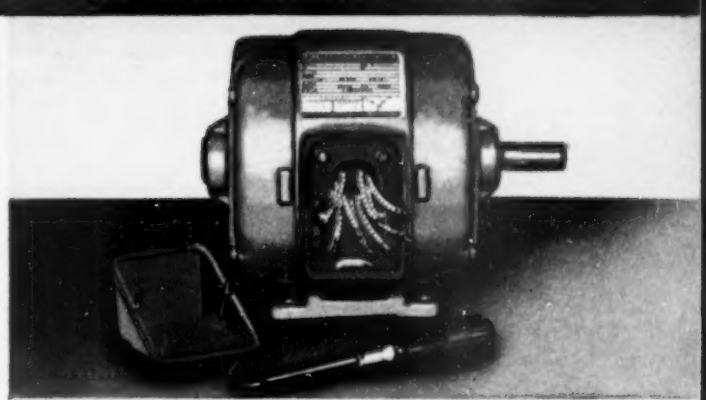
HIGHER FULL-LOAD SPEEDS is only one of many improved characteristics of this new G.E. motor. Above shows comparison of an ordinary motor with the Tri/Clad '55' — both rated at 3600 rpm.



SONANT OPERATION of the new Tri/Clad '55' motor has been laboratory tested and proven. Motor operates at reduced noise level, and operating sound is pitched to a more pleasant frequency.

YOU GET EVEN MORE INSTALLATION AND MAINTENANCE SAVINGS

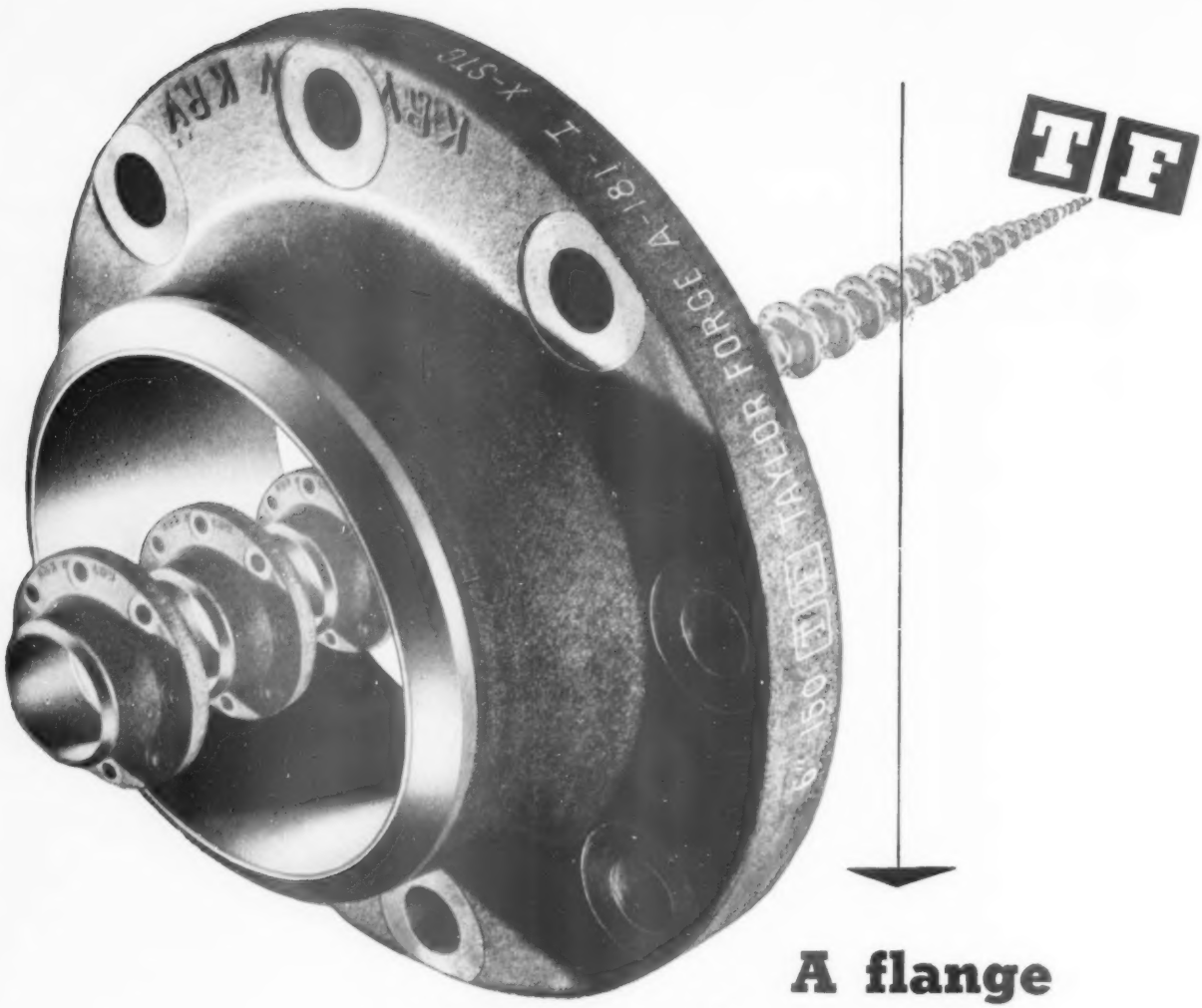
NEW BEARING SYSTEM allows this motor to run longer than other motors without regreasing. One reason—greatly improved synthesized grease with 8 times the mechanical stability of ordinary grease.



EASIER TO SERVICE, the new Tri/Clad '55' has larger conduit box diagonally split for simplified wiring. Perma-numbered leads mean that even clipped and stripped wires are instantly identified.

Progress is our most important product

GENERAL ELECTRIC



A flange with a background...

You are looking at a flange with a history. Taylor Forge made the forged steel flange and in a sense the forged steel flange made Taylor Forge. It was Taylor Forge, back in 1905, who made the first forged steel flanges on a commercial scale . . . and it is Taylor Forge who has guided flange development across the past half century.

Through the first threaded flange form, the bolted Van Stone form, and the perfected welding neck form pictured here, Taylor Forge has undeniably contributed more to flange development than any other organization*.

Taylor Forge Welding Neck Flanges are a part of the WeldELL® line—the line that more than 20 years ago gave industry the first complete line of fittings for pipe welding. The organization that led development is still leading . . . in scope of types, sizes, weights, materials . . . in quality and downright value!

For up-to-the-minute facts see your Taylor Forge Distributor

TAYLOR FORGE

TAYLOR FORGE & PIPE WORKS, General Offices & Works: P.O. Box 485, Chicago 90

Plants at: Carnegie, Pa., Fontana, Calif., Gary, Ind., Hamilton, Ont., Canada

* When pressures rose from the old 150- and 300-pound standards to 400, 600 and finally 900 pounds, it was largely the exhaustive research of Taylor Forge that supplied the formulas for determining stresses in flanges for any given condition of loading. Among many examples: the Taylor-Waters formula, published in 1927, became and still is the basis of recognized practice for flanges in sizes through 24". Again, in 1938 Taylor Forge published the first edition of the now authoritative "Modern Flange Design" based on methods proposed by E. O. Waters, D. B. Rossheim, D. B. Wesstrom and F. S. G. Williams, Taylor Forge Manager of Engineering Standards. (ASME Trans., Apr. 1937)

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DIGEST OF NEW EQUIPMENT

IT'S NEW CHECK IT

by Dan B. Miller

1 MODEL 190 HEAVY-DUTY BACKFILLER is a one-man-operated, fast-moving, big-capacity backfiller for pipe lines and heavy construction work. It is especially effective under the more rugged and difficult conditions; in mud, sand, and rocky soil, in swamps and hilly terrain. Employing a 7-ft. backfill board, the machine backfills as it travels, providing continuous operation under one-man control. Long, wide crawlers give the 190 an extremely low ground-bearing pressure, 6.2 psi. The modern crawler unit has double-rimmed sprockets, antifriction bearing, and mounted wheels and rollers, eliminating track packing and effecting greater stability. The unit is 15 ft. in length and 9 ft. 10 in. in height, and has an over-all width of 8 ft. Not including the boom, it weighs approximately 22,500 lb. *Cleveland Trencher Co.*

IT'S NEW CHECK IT

2 NEW 150 HP. D8 TRACTOR. Incorporating increased horsepower, weight, and engineering advancements which contribute to increased production at lower operating cost, the new D8 is the latest development in the crawler field. A Caterpillar-built diesel engine with an output of 185 hp. operating at a governed speed of 1,200 r.p.m. powers the unit. A new cylinder head incorporates improved valve springs. Valve rotators lengthen service of engine valves. Valve-seat inserts of specially hardened metal for inlet and exhaust valves increase durability and simplify servicing. In connection with the oil-pressure control system, even cold, stiff oil is quickly forced through the lines to the bearings to provide prompt lubrication under the most severe weather conditions. In first gear the new D8 will develop a drawbar pull, with standard transmission, of 29,200 lb., and with the optional heavy-duty transmission, a drawbar pull of 39,800 lb. Speeds of the latest D8 are increased over earlier models. Forward travel speeds with standard transmission are; first, 1.9 m.p.h. or 167 ft. per minute; second 2.7 m.p.h. or 238 ft. per minute; third 3.5 m.p.h. or 308 ft. per minute; fourth 4.5 m.p.h. or 396 ft. per minute; fifth 5.8 or 510 ft. per minute. *Caterpillar Tractor Co.*

IT'S NEW CHECK IT

3 NEW RING-BALANCE METER SIGNAL TRANSMITTER. This makes the meter readily adaptable to a wide variety of remote metering and control applications, including control installations requiring reset, remote adjustable set-point, and rate action. The transmitter is actuated by movement of the pen arm or indicator follower of the meter, without introducing any perceptible load on the sensing element. These movements are transmitted to a baffle which moves about a fixed pivot to throttle air discharge from the control nozzle. Sensing element movement is converted into a proportional pneumatic signal that follows any function measured. Available maximum signal pressure ranges are 15, 30, and 60 psi. This requires a continuous supply of compressed air. The change from one signal range to another requires only the substitution of the proper calibrating spring. The minimum signal pressure may be substantially zero, or may be suppressed to 3 or 5 psi. Output from the

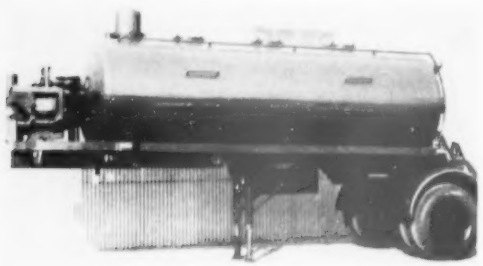
KEEP INFORMED ✓SAVE TIME ✓TEAR OUT CARD ✓CHECK IT ✓MAIL IT

This Digest of New Equipment offers you a quick resume of important features of new or improved products and trade literature and the opportunity to obtain complete information on each subject by use of the convenient "CHECK IT - MAIL IT" service card.

transmitter can be used to actuate receiver-type indicating, integrating, or recording instruments, or as the actuating signal for an automatic control system. *Hagan Corp.*

IT'S NEW CHECK IT

4 TRAILER-MOUNTED VACUUM TANK has a 55-bbl. capacity and attaches to any tractor. It is completely self-sufficient with tank, engine, pump, and four-way valve.



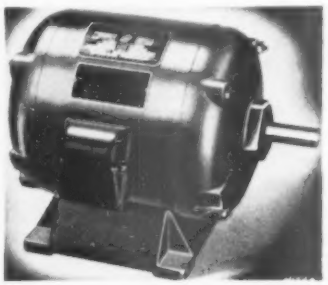
It is easily operated by one man to handle water, oil, mud, or chemicals. Liquids can also be moved through the vacuum unit so that, where large quantities are to moved at high speed, the trailer can be employed as a transfer unit without tying up a truck. In drilling operations, rotary mud can be loaded and moved between sites quickly, thus effecting major economies in time and materials. In a typical timed operation, it took less than 10 minutes to suck 55 bbl. of 12-lb. mud into the tank, and 5 minutes to empty it. Brine, caustics, acids, bleaches, and acid sludge are normal cargo. The tank is also an ideal tool for agitating drilling mud. The unit will speed repairs in pipe lining where the vacuum can be used to bell hole and its strong reverse pressure rapidly puddles trenches. Spills and leaks of all kinds can be sucked into the tank for later disposal. *Thompson Tank & Manufacturing Co.*

IT'S NEW CHECK IT

5 SK SAFEGUARD ROTAMETER. A completely enclosed steel meter case with detachable safety-glass windows protects the metering tube from external shock, and acts as a safeguard in the event of accidental tube breakage. Extremely rigid construction gives precise end fitting alignment, eliminating pipe stresses on the Rotameter tube. Versatility is achieved by standardized construction which permits the use of up to four sizes of meter tubes in one meter case. In addition, the variety of rotor designs available afford a wide range of capacities within one meter size. Extra-wide front and rear sight windows provide maximum visibility, and the detachable metal reference scale is plainly marked for ease in reading rate of flow. Scales are available calibrated either in units of flow, or in millimeters for use with calibration charts. *Schutte & Koerting Co.*

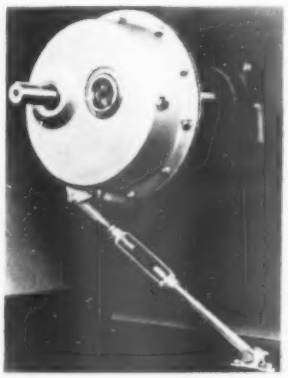
IT'S NEW CHECK IT

6 A NEW LINE OF INTEGRAL HORSEPOWER MOTORS has been designed to provide smooth, economical changeover to the new standards prescribed by National Electrical Manufacturers Association, it has been announced by electric motor division of A. O. Smith Corp. The new design is composed of rolled-steel main-frame construction with attached malleable-iron-base mounting as required. End frames are of durable cast iron. They are so constructed as to insure maximum ventilation to working interior parts, yet they meet requirements of dripproof application. Rotor diameter fans are employed, the blades being cast integral with pressure cast end rings and rotor bars. This assembly rides on ball bearings throughout the entire line. Quietness of operation is assured by the rigid construction and excellent alignment obtained through the use of cast-iron end frames mated with rolled-steel, seam-welded main frames. The line now includes 203, 182, 204, and 184 frames with all standard horsepower ratings in these sizes. This production will shortly be followed by the next frame diameter which will encompass 224, 213, 225, and 215 N.E.M.A. frames, including 3 and 5-hp. ratings. *A. O. Smith Corp.*



IT'S NEW CHECK IT

7 NEW FALK SHAFT-MOUNTED DRIVE. A new speed reducer mounts directly on the shaft to be driven and requires no floor space other than that needed for the motor and tie-rod connection. Easily adapted to fit various driven shaft diameters, this drive offers comparatively high ratios of speed reduction in very limited space. A choice of single or double-reduction unit makes possible the selection of almost any output between 420 and 14 r.p.m., by changing sheave sizes within allowable limits. There are sizes to cover the range from ½ to 30 hp. The unit features all-steel construction, highly efficient helical gearing, and positive lubrication. *The Falk Corp.*



IT'S NEW CHECK IT

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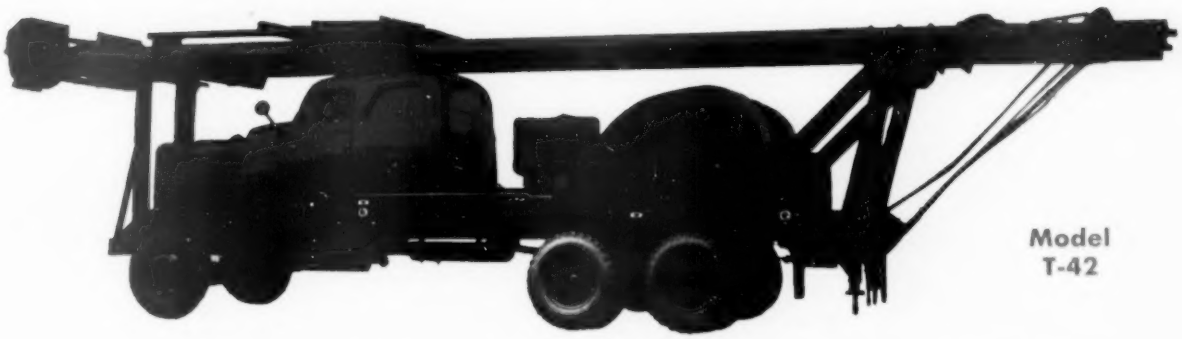
for 6,000′ to 10,000′ Servicing



Model
T-42

COOPER Self-Propelled SERVICING WINCH

It's not a truck with a winch added on, but a single unit engineered from the ground up for the specific purpose of servicing oil wells.

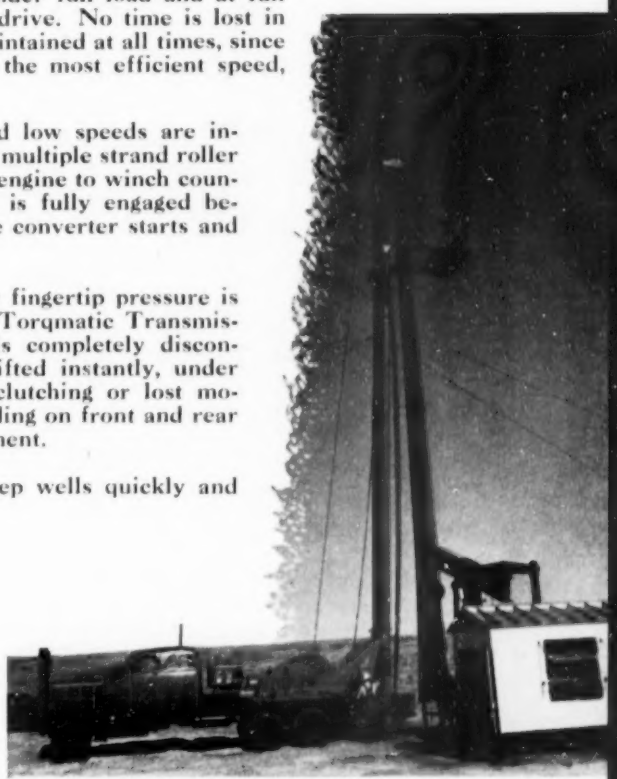
TORQUE CONVERTER–TORQMATIC TRANSMISSION FOR MAXIMUM EFFICIENCY, SPEED AND EASY OPERATION.—The three speed Torqmatic Transmission can be shifted under full load and at full speed without slowing down or declutching any drive. No time is lost in stopping to shift gears. Maximum efficiency is maintained at all times, since the engine and Torque converter can be run at the most efficient speed, regardless of load.

ONLY ONE AIR FRICTION CLUTCH is used in drum, high and low speeds are instantly available in Torqmatic Transmission. Only one short multiple strand roller chain is used in drum drive. Torque tube drive is used from engine to winch countershaft. Clutch slipping to start load is unnecessary. Clutch is fully engaged before applying power, eliminating wear and heat. The Torque converter starts and smoothly accelerates the load.

ON THE ROAD, power steering makes it easy to drive. Only fingertip pressure is required to turn wheels even when standing still. The same Torqmatic Transmission drives both winch and tandem axle. Drive not in use is completely disconnected. There are no idling drives. Transmission can be shifted instantly, under full power, into any gear as road conditions require. No declutching or lost momentum. Proper load distribution engineered for proper loading on front and rear axles and with sufficient bed space for tools and other equipment.

AMPLE POWER, brakes and line capacity to service your deep wells quickly and safely. Your choice of Diesel or Gas Engines.

EXTRA EQUIPMENT–Rotary drives, telescoping mast, tubing boards, rod hangers, catheads, drum dividers, line guide shells and air compressors for tongs. Single or double drum models.



The most complete line of well servicing equipment. There is a proper size and type to fit any depth wells or any field condition. You can service them faster, safer and at less cost with a COOPER.

FRED E. Cooper, Inc.

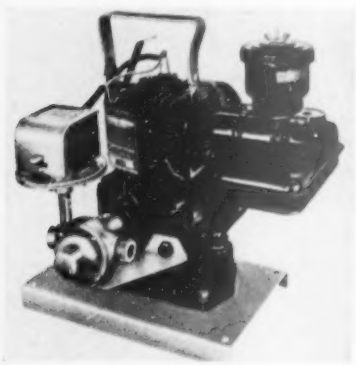
P. O. BOX 1890 TULSA, OKLA.

Houston, Odessa, Los Angeles

8 NEW RUST-INHIBITING OIL ADDITIVE. The new inhibitor is a sorbitan fatty-acid ester, essentially 100 per cent active, and shipped as an oily concentrate to be added to oil by the refiner or compounder. The new product, identified as Atpet 100, offers considerably more protection than other nonmetallic inhibitors used at the same concentration. It is a synthetic, therefore its manufacture is fully controllable. Consistency is maintained in production, and safeguarded by 100 per cent testing of each batch produced. Addition of Atpet 100 has no effect on pour point of some oils, and a slight effect on that of others. At 4 to 5 per cent weight concentration, it raises the pour point 15° F., an effect overcome by addition of a slightly greater quantity of pour-point depressant. The more paraffinic the oil, the more vulnerable it is to elevation of pour point. Experience thus far shows that Atpet 100 is miscible with refined oils by ordinary mixing procedures, by light stirring with heating applied to the components when needed. *Atlas Powder Co.*

IT'S NEW CHECK IT

9 HYPRO G 3800 VS PORTABLE PUMP. Complete portability and functional simplicity are two of many features of a new gasoline-engine-powered pump designed for oil or water transfer. The hollow-shaft pump mounts directly on the drive shaft of Model 5S 1-hp. Briggs & Stratton gasoline engine, and will run for 1¾ hours on a tank of fuel. The unit shown is equipped with a special vacuum switch to guard against "burned out" impellers when the liquid supply runs dry. Use of the switch means that the pump may be operated untended, and will shut itself off when the pumping job is finished. The unit weighs 35 lb. complete with engine, fuel tank, hinged carrying handle, and base plate. Capacity of the pump is up to 8 g.p.m. open discharge. Pressure range is up to 30 lb. It will lift water up to 10 ft. unprimed, 22 ft. primed, and has outside threaded ports to accommodate hose couplings. It will handle a wide range of liquids on transfer or booster pumping duty. *Hypro Engineering, Inc.*

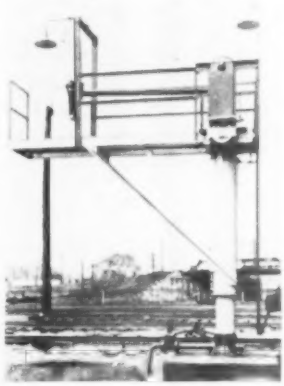


IT'S NEW CHECK IT

10 KOLMETAL is a new coating material for cooling and condensing sections. Heat-transfer efficiency is maintained while the coating resists corrosive action. The coating is a mixture of finely pulverized aluminum powder in a special plastic vehicle. The metallic particles comprise about 85 per cent by volume of the mixture. The plastic base completely seals the metal particles to make a tightly bonded, flexible, and adherent coating. Coated sections now under test for more than 2 years are in contaminated salt water with a pH of 4 to 5. In this exceptionally severe service uncoated cooling sections required extensive cleaning at the end of 2 years to restore efficiency. The sections were covered with unusually heavy oxide and organic slime deposits. In the same stack identical sections with Kolmetal coatings were clean and free of corrosion at the end of 2 years. As a result of operational experience, the company is now offering Kolmetal coated cooling sections along with uncoated sections. National Radiator cooling sections already in service can also be given this protective coating if they are thoroughly cleaned by sand blasting to remove all traces of oxidation, scale, or other surface contamination which would weaken adhesion. *National Radiator Co.*

IT'S NEW CHECK IT

11 DOME UNLOADING DEVICE FOR TANK CARS. The device consists of an oversize pipe column support surrounded by a movable pipe column that supports the operator's platform. The movable pipe column and operator's platform rests on an oversize Timken thrust-type roller bearing, which permits the operator to turn the safety platform 360° very easily by hand-wheel operation, if desired. The movable pipe support is kept concentric about the fixed column with the aid of radial bearings mounted on vertical cam-type spindles for maintaining accurate alignment. A 4-in. diameter extra-strong oil pipe is provided that extends down into the fixed supporting column and is securely attached to the base supporting casting. This pipe is long enough to extend up through the operator's platform at a desirable height, and to which is connected the high-grade swing joints and horizontal pipe, elbow, and upper half of the lever-operated quick-coupler. For completing the suction pipe run above the platform a 4-in. aluminum alloy light section suction pipe is provided with foot strainer and lower half of the clamp coupling. *The Nichols Engineering Co.*



IT'S NEW CHECK IT

12 FORMULA 291 is a new emollient and skin-protective salve recommended by its manufacturer for those whose skin may be exposed to the toxic effect of fumes encountered in application of corrosion-control coatings. It is packed in a 1-lb. jar, and contains lanolin compounded with other special ingredients. It will be stocked both for the pipe line and tar-base coating fields. *S. D. Day Co.*

IT'S NEW CHECK IT

TRADE LITERATURE

For Copies of These Informative Brochures, Check the Corresponding Number on the TIME SAVER CARD

13 POROUS KEL-F. Brochure No. T-103 describes pure porous Kel-F, a new filtration medium completely resistant to all strong acids, caustics, oxidizing agents, and common organic solvents. Engineering data presented include physical properties and minimum flow capacity curves for air and water. *Porous Plastic Filter Co.*

14 ENGINE-TYPE SYNCHRONOUS MOTORS. Standard construction features of engine-type, slow-speed synchronous motors in ratings of 100 hp. and larger at speeds of 450 r.p.m. or less are described in Bulletin O5B8008. Stator, rotor, and collector assembly features are described and illustrated with photos. In addition, such modifications are extra flywheel effect, split rotor, and split stator are given. *Allis-Chalmers Manufacturing Co.*

15 SELECTIVE CALLING EQUIPMENT. Complete detailed information on selective calling equipment for individually controlling radio-equipped vehicles is available in a two-color, four-page bulletin. The literature describes both the push-button type of equipment in which contact with a two-way radio-equipped vehicle or fixed station can be made within 0.8 second, or the economical dial-operated system. The equipment is designed to help eliminate the confusion caused by overcrowded radio spectrum and skip-distance reception. *Hammarlund Manufacturing Co.*

16 TWO SECTIONAL DRIVE GROUPS for Ideal Type 55 consolidated drilling rigs are presented in a new 16-page, illustrated Bulletin No. 416. Both are two-section-drive groups with two engines in the 300-hp. range with torque converters. The bulletin covers Type CB-LS, designed for the output speed usually provided by 900-r.p.m. engines, and the Type CB-HS which permits use of various combinations of engines of higher output speeds. *The National Supply Co.*

17 FUEL-OIL HEATERS. The bulletin describes two types of these G.-R. units: the Twin G-Fin section with longitudinally finned heat-transfer elements, and the Type B tubular heater; and explains the details of design and features of both type, with sectional views, illustrations of installations, specifications, and dimension tables. Also included in the bulletin are selection tables for the Twin G-Fin section for capacities ranging from 50 to 31,000 lb. per hour of 10° A.P.I. fuel oil, and the Type B heater for capacities ranging from 2 to 1,000 g.p.m. of Bunker C fuel oil; with oil to be heated from 100° to 225° F., and for pressures from 25 to 250 psig. in both tables. *The Griscom-Russell Co.*

18 MONO-KOVER, the new lightweight one-piece pipe insulation is the topic of a four-page, three-color bulletin. The description of the ease with which Mono-Kover may be applied is accompanied by photographic illustrations. Other characteristics of Mono-Kover described are its thermal resistance, permanence, resiliency, noncorrosive properties, and lower applied cost. Added features are a chart indicating thermal efficiency of Mono-Kover, a suggested specification form, an insulation-thickness selection table for insulation surface temperatures, and a table showing available sizes, thicknesses, and packaging data. *Baldwin-Hill Co.*

19 GETTING THE MOST OUT OF YOUR VALVES. The booklet covers the selection of valve types, and materials, installation, and operation hints, as well as inspection and maintenance pointers. *The Cooper Alloy Foundry Co.*

20 TUBULAR EQUIPMENT FOR PROCESS APPLICATIONS. The free literature illustrates and describes the company's standard exchangers employing IPS shells. According to the literature, by modification of basic tube sheet templates, units are predesigned and fabricated of standard components in one, two, four, six, and eight-pass tube arrangements in various types, and their common modifications. Any tube length may be employed and pressure ratings of 75, 150, and 300 psig. code are available. *Colonial Iron Works Co.*

21 FIRE PUMP BULLETIN. The bulletin describes specifications for the pump, designed to provide constant protection against fire in industrial installations. The vertical turbine fire pump will provide an adequate independent water supply to serve as the first line of fire defense for plants in areas where the primary water supply is limited, or where there is no municipal water supply at all. The plants can, with this pump, maintain their

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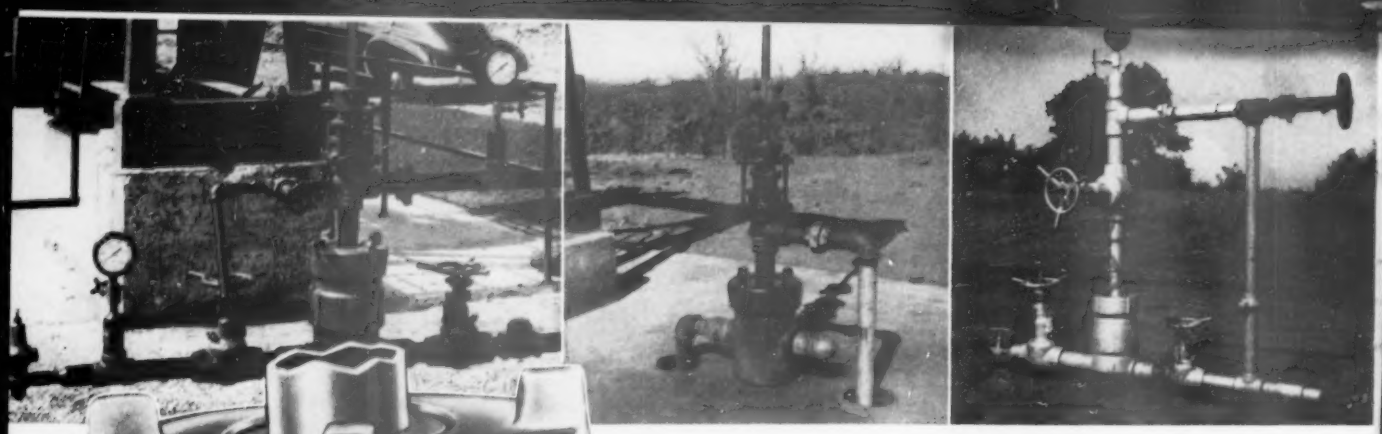

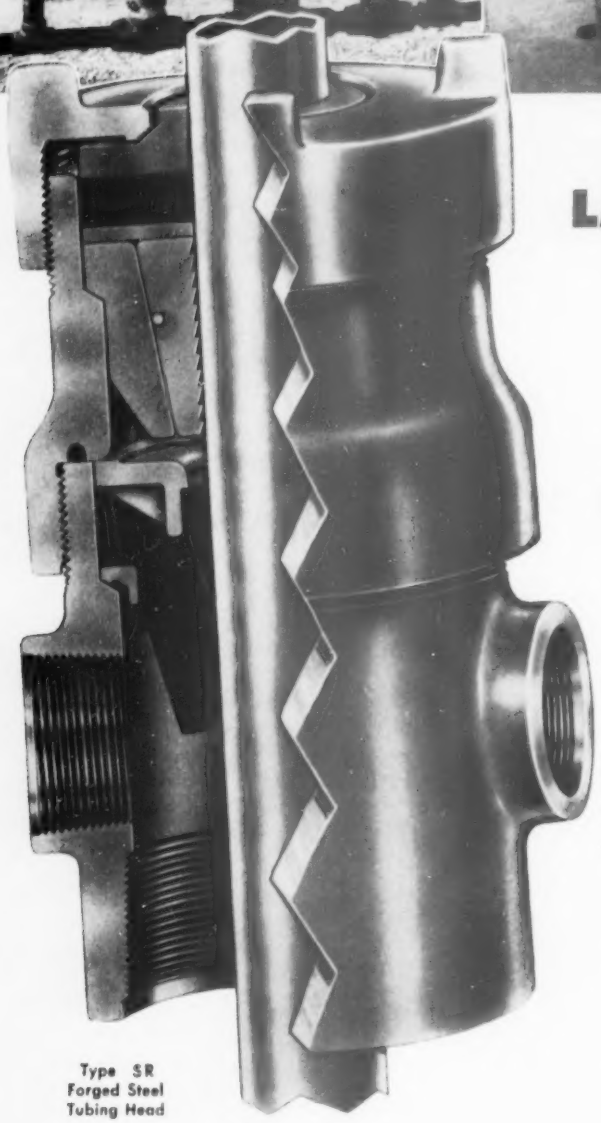

Type SR
Forged Steel
Tubing Head

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Larkin **All-Purpose** Forged Steel Tubing Heads, illustrated at left and below in three basic types, are adaptable to any flowing, gas-lifting or pumping system. All standard and accessory parts are interchangeable within the head body, providing easy conversion when varying conditions make necessary a change in the hook-up. Either mandrel or slip-type suspension may be employed.

All Larkin Tubing Heads are full opening and are rated at 4500 p.s.i. test. The durable neoprene stripper provides ample blow-out protection during completion or work-over operations.

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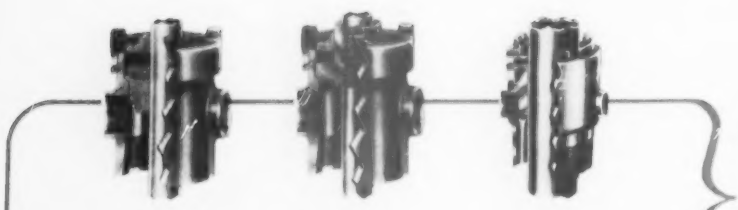
LARKIN PACKER CO., INC.
St. Louis, Mo.



Type R
Forged Steel
Tubing Head

Type M
Forged Steel
Tubing Head

Larkin
Casing Head
(Fig. 91)

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own supply at the necessary pressures for fire fighting, from wells, streams, or reservoirs. *Worthington Corp.*

22 HONEYWELL MERCURY SWITCHES. This 12-page Catalog No. 90 covers standard designs of Honeywell mercury switches for use in a.c. or d.c. industrial switching applications that provide low force and tilt motion. The catalog covers five families of switches, classified as protected, heavy-duty, general use, small, and sensitive mercury switches. In all, 29 catalog listings are included. This new catalog gives complete information on each switch, including dimensions, description, electrical rating, differential angle, lead wires, and the type of application that each switch is suited for. *Micro Switch Division, Minneapolis-Honeywell Regulator Co.*

23 DRAWING SHOWS APPLICATION OF ALUMINUM JACKETING. One of the most frequent problems in the use of aluminum jacketing on insulated lines is how ells, tees, and bends should be weatherproofed. This drawing shows three practical methods for this part of the job. The information shown in this drawing is derived from experience in the field on all sorts of applications, and can be valuable to insulation contractors, engineering and design firms, and plant engineers. *Childers Manufacturing Co.*

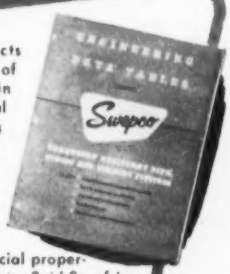
24 PULSATION DAMPENERS. Engineering details and illustrations of pulsation dampeners installed on drilling rigs, at pipe-line stations, in fuel systems, and on oil-well cementing trucks are presented in a 28-page, 2-color brochure that is perforated for binding. *Gadco Products, Inc.*

25 ELECTRODES—PLANT AND ACCESSORIES FOR ELECTRIC ARC WELDING. A new 42-page catalog lists a full line of mild steel and special electrodes in addition to a full line of arc-welding accessories including welding plants, shields, electrode holders, and a.c. and d.c. motors. *The Quasi-Arc Co., Ltd.*

26 OTIS SERVICES FOR PERMANENT COMPLETIONS, a multicolor, six-page brochure gives the basic information needed to set up wells for this new completion and recompletion method. Among features of this method is quick and low-cost testing of multiple sands. There are line illustrations of equipment employed in this method and descriptions of remedial operations. *Otis Pressure Control, Inc.*

VALUABLE NEW
Swepco
BOOKLETS
for users of Pipe & Tubing

1. This illustrated catalog covers latest developments in the manufacture of Swepco's large diameter, corrosion resistant pipe, tubing and welding fittings — new features such as extra high finishes and tolerances exceeding those of seamless. Sections on metals and alloys, sizes, lengths, weights and dimensions.



2. Here are facts and formulae of unusual help in solving practical pipe and tubing problems. These tables, many unobtainable elsewhere, include corrosion resistance charts, special properties, pipe flow data, fluid-flow-friction losses, beam formulae, ASTM specifications, bolt strength, tank capacity and miscellaneous data.

SEND FOR YOUR FREE COPIES NOW!

Swepco pipe, tubing and welding fittings, 3" to 48" O.D., are obtainable in stainless steel, nickel alloys, titanium, Carpenter "20", Hastelloy alloy, other alloys. Lengths up to 20 feet; extra heavy schedules and with high cylinder finishes. Rigid inspection of every shipment is assured.

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Here is the most economical, efficient way of putting cathodic protection to work on your pipeline. By plowing in Galvo-Line®, Dow's cored, flexible magnesium ribbon anode, you can protect up to five miles of pipeline per day!

Galvo-Line was designed specifically to cut installation costs. Using a tractor or truck and a cable-laying plow, Galvo-Line can be buried at better than 3000 feet per hour. That is the equivalent to installing about 35 packaged anodes in the same time. The installation is also simplified by the reduced number of connections to the pipeline, 500 to 1000-foot intervals being generally adequate.

By its design, Galvo-Line gives you better performance, too. Its special composition and greater surface area provide more current per pound of magnesium buried. Because the current is uniformly distributed, Galvo-Line protects with less current per foot of pipe. Experience shows anode life of up to 10 years in all except low resistivity soils.

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PIPE LINES

New Lines Open

Increasing volumes of gas moving from Permian basin

MIDLAND, Tex. — Nearly 100,000 M.c.f. of gas daily is flowing out of the Permian basin through new pipeline facilities.

About 40,000 M.c.f. of it is Spraberry gas moving north-northwest through the completed portion of Permian Basin Pipe Line Co.'s system from the Spraberry to Plains in Yoakum County, Texas. Another 52,000 M.c.f. of gas from the high-pressure producing fields south of Hobbs, N. M., is flowing northeast through the Hobbs-to-Yoakum County branch of the system.

Gas production and transmission from both of these areas will go into high gear by March 1 when El Paso Natural Gas Co. completes its new 30-in. northern system from Yoakum County through Gallup, N. M., to Topock, Ariz., on the California border.

El Paso's big 30-in. main-transmission line from Yoakum County west has been completed to within 25 miles of Gallup, N. M., where it will join the already-completed western segment of the line from Gallup west to Topock. The western segment loops an existing 24-in. line.

Some gas, coming from the San Juan basin to the north through still another line, already is moving through the western segment of the 30-in. line. The new system will have a capacity in excess of 300,000 M.c.f., and is slated for completion March 1.

Delivery to rise . . . It is expected that Permian Basin Pipe Line will be turning over 200,000 M.c.f. of gas daily to El Paso later in the year in Yoakum County, and 300,000 M.c.f. daily next year.

An equivalent amount made up of El Paso-controlled gas in the Texas Panhandle and south of Hobbs will be turned over to Northern Natural Gas Co., parent firm of Permian Basin Pipe Line, at Dumas, Tex., in the Panhandle.

The New Mexico gas will be transported from Hobbs by Permian Basin to Plains in Yoakum County, entering an El Paso line there to Dumas where it will move through a new 14-mile line laid by Northern to its Sunray, Tex., station, and thence on north through Northern's main transmission system.

Normal gas flow through the Plains to Dumas line was recently reversed by El Paso in accordance with the agreement with Northern and Permian.

Construction crews were scheduled to have completed late last week the laying of the last remaining portion of the Permian main line—the 70-mile stretch of 20-in. from Plymouth to Puckett field.

Considerable work remains, however, on the gathering system on the southern end of the line in the Puckett field area. Gas from wells in this area will be processed in Permian's $3,000,000 carbon-dioxide removal plant in Pecos County before being transmitted north through the system. Completion of this plant is expected by the time the 20-in. line and gathering system are ready for operation.

Proposal Amended

Plans for moving Canadian gas to Northwest changed

WASHINGTON. — Northwest Natural Gas Co. has proposed an amendment to its application to build a natural-gas transmission system to transport gas from Canada to markets in the Pacific Northwest.

The proposed amendment would reduce the area the company would serve if its application is approved by the Federal Power Commission.

Northwest Natural originally proposed to serve eastern Washington and nearby adjoining areas as well as the coastal area of Washington, Portland, Ore., and Vancouver, B. C.

Amended service . . . The amended proposal of the company is for service of northern Idaho and eastern Washington, with some gas to be returned into Canada for use in Trail and elsewhere in British Columbia.

The smaller project, as now proposed, would cost an estimated $36,000,000, compared with the estimated cost of $89,000,000 for the original project. The amended project, involving about 665 miles of pipe line, would have a maximum daily delivery capacity of 120,000 M.c.f. of gas in the fifth year of operation, with average daily deliveries of about 86,370 M.c.f.

The originally proposed line of Northwest Natural would have had a maximum daily delivery capacity of 285,000 M.c.f.

Hearings on Northwest Natural's ap-

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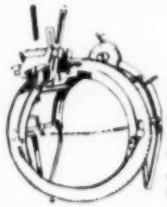
PIPE CUTTING AND BEVELING MACHINE



Gives you consistently uniform cuts under toughest field conditions. Unsurpassed in efficiency and economy. Full circle Traveling Ring eliminates jerky movement. Machines accommodating up to 14" pipe are equipped with standard type torch holder. Machines accommodating 16" pipe and larger are equipped with out-of-round attachment.

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1 Photo showing Peerless Line Separators at Pipeline Station in Oklahoma.

2 Peerless Horizontal Separator handling 240,000,000 cu. ft. per day, while removing condensed liquid from cooling tower, at plant in California.

3 Two Peerless Vertical Scrubbers at a power plant in South Texas, each handling 50,000,000 cu. ft. of gas per day.

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plications, and those of several competing companies, started in June 1952 before the FPC and are still in progress.

Gas supply . . . The amended proposal says Northwest Natural expects to get gas from Pincher Creek field, but that it may be required by the Petroleum and Natural Gas Conservation Board of Alberta to take gas from other fields in Alberta.

Pawnee Proposes Crude Line In Colorado's Adena Field

BRUSH, Colo.—Pawnee Pipe Line Co. has proposed the construction of a 35-mile, 10-in. crude-oil pipe line and 6 and 8-in. gathering lines in Adena field in Morgan County, Colorado.

The plan for the pipe-line system in Colorado's newest oil field was submitted to the Colorado Public Service Commission by Pawnee. Pawnee is owned by Pure Oil Co. and Sinclair Pipe Line Co.

The proposed line would run from Adena field to a terminal at Merino and would have a capacity of 45,000 bbl. of crude daily. Construction schedules call for completion of the new line within 60 days after approval, with reasonable weather.

Joseph W. Meehan of Pure Oil Co. is Pawnee president, and Earl W. Unruh of Sinclair is vice president. Pure has been one of the major operators in Adena field.

FPC Proposes Schedule of Fees for Applications

WASHINGTON.—Proposed schedules of fees for filing of applications, granting of authorizations for export and import of natural gas, and for issuance of certificates under the Natural Gas Act have been announced by the Federal Power Commission.

Proposed filing fees for applications for construction or acquisition of new or additional facilities, or extension or interconnection of facilities when estimated cost is less than $500,000 would be $150; $500,000 to $1,999,999 would be $200; $2,000,000 to $3,999,999 would be $300; and $4,000,000 or more would be $500 plus $100 for each additional $1,000,000 or fraction thereof.

Upon granting a certificate, the FPC would levy an assessment of an amount not to exceed 0.1 per cent of the estimated cost of the certificated facilities.

The proposed fee schedules have been set up in accordance with an act

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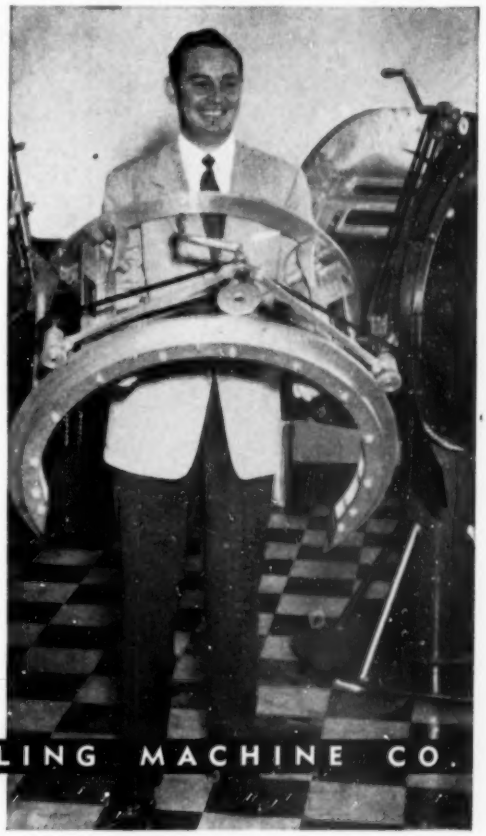

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Colorado Gathering System Planned by Nine Operators

DENVER.—Plans for construction of a natural-gas-gathering system and a compressor station in Little Beaver and Badger Creek fields in Washington and Adams counties, Colorado, have been announced by operators in the fields.

Representatives of Col-Tex Oil, Inc., Continental Oil Co., Denver Basin Oil Co., Forest Oil Corp., Goodall Oil Co., Lion Oil Co., Sinclair Oil & Gas Co., Triangle J. Oil Co., and Calstar Petroleum Co. made the agreement for the project.

Continental has been named temporary operator of the gathering system and compressor station, which are expected to be in operation by midsummer.

The operators also authorized the "design and economic study of a suitable absorption and/or refrigeration-type plant" to remove liquids from the gas. Marketing plans for the gas and byproducts were not announced.

Corrosion Short Course Set for Tulsa This Week

TULSA.—A short course on the practical control of corrosion, sponsored by the Tulsa section of the National Association of Corrosion Engineers, will be held at the Mayo Hotel here, February 17-19.

Registration for the short course will start at 7:30 a.m., February 17. The registration fee will be $10.

Right and wrong ways of applying corrosion mitigation practices will be demonstrated and discussed.

L. W. Phinney of International Rectifier Corp. will discuss location of rectifier trouble.

Insulating flanges will be discussed by John E. Searcy, of Service Pipe Line Co. "How Not to Do It in Cathodic Protection," will be the subject of a dialogue directed by Earl O. Owens, of T. D. Williamson, Inc.

In the morning of February 19 there will be a field trip to the plant of Tulsa Pipe Coating, Inc., where W. P. McCollister of Phillips Petroleum Co. will demonstrate anode-installation methods. Practices for coating application will be shown.

In the afternoon of February 19, ther will be a round-table question-and-answer session at Tulsa University.

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REFINING

Corpus Christi Completing Refinery Expansion Program

CORPUS CHRISTI, Tex.—Completion of an expansion program this month at Corpus Christi Refining Co.'s plant will raise rated crude capacity to 8,000 bbl. per day.

Primary facilities include a 6,500-bbl. topping unit, a 2,000-bbl. vacuum unit, and 200,000 bbl. of storage capacity, with some 160,000 bbl. more storage to be added later.

With all units operating, plant production will balance out to produce 4,000 bbl. of jet fuel, 1,200 bbl. of gasoline, 1,600 bbl. of gas oil, and 1,200 bbl. of fuel oil.

Original facilities at the plant included a 600-bbl. crude unit. The plant was purchased by Corpus Christi Refining in September 1952 and revamped to increase its throughput to 1,800 bbl. daily.

The company was incorporated in February 1953 and in December the facilities of Inland Refining Co., Palestine, Tex., were purchased. Expansion plans at that plant call for the addition of 140,000 bbl. of storage *(The Oil and Gas Journal, December 28, page 121).*

The new plant facilities were designed and engineered by Emil Geppelt, consultant. Construction was carried out by Service Boiler Works Co. and Texas Engineering & Construction Co.

Richfield Plans Big Smog Outlay in Next 15 Months

LOS ANGELES, Calif.—Richfield Oil Corp. will spend $1,680,000 on special antismog equipment at its Los Angeles basin refinery and storage areas during the next 15 months.

Of the total, $500,000 will be spent on improvements and new air-pollution control installations being made in connection with existing refinery facilities; $500,000 will be spent to minimize evaporation from storage tanks; and $680,000, included in the company's $40,000,000 refinery expansion project to be completed this year, will be spent for devices to capture vapors and particulate waste material.

Floating roofs are being installed on some tanks and others are being connected to an existing vapor-collecting systems in the effort to minimize evaporation from storage tanks, in compliance with a requirement of the Los Angeles Air Pollution Control District.

The antismog equipment expenditures in the next 15 months will bring the company's investment in a clean-air program since World War II to $3,000,000.

Sunray Begins Work on Coking Unit at Duncan

TULSA.—Construction is now under way on a 9,000-bbl. per day delayed coking unit at Sunray Oil Corp.'s Duncan, Okla., refinery.

The new unit, to be owned by Ucan Products Co., is scheduled for completion by October 1954. Ucan, a new firm organized by Sunray and manned by Sunray personnel, will operate the unit and market coke products through Great Lakes Carbon Co.

In addition to coke production, the new plant will upgrade No. 6 fuel oil into propane, propylene, butane-butylene, debutanized gasoline and gas oil for additional catalytic charging stock. Lummus Co., Houston, is constructing the plant.

Esso Standard Lets Contract For New Houdriformer Unit

BATON ROUGE, La.—C. F. Braun & Co. has been awarded contract for construction of a 25,000-bbl. per day fluid Houdriformer at Esso Standard Oil Co.'s 312,000-bbl. per day refinery here.

H. J. Voorhies, vice president and general manager for Esso here, said construction of the $12,000,000 project will begin about March 1. It is scheduled for completion in November.

The new unit will permit an increase in total gasoline production at Baton Rouge by converting low-octane naphtha fractions to high-octane blending stocks for motor fuel and aviation gasoline.

Williston Basin's Refinery Completion Is Delayed

WILLISTON, N. D.—Completion of Williston Basin Refinery Co.'s new 1,500-bbl. per day refinery east of here has been delayed, according to Robert F. Mowdy, president.

The refinery, originally scheduled for completion January 1 *(The Oil and Gas Journal, October 5, page 150),* will probably not go on stream until

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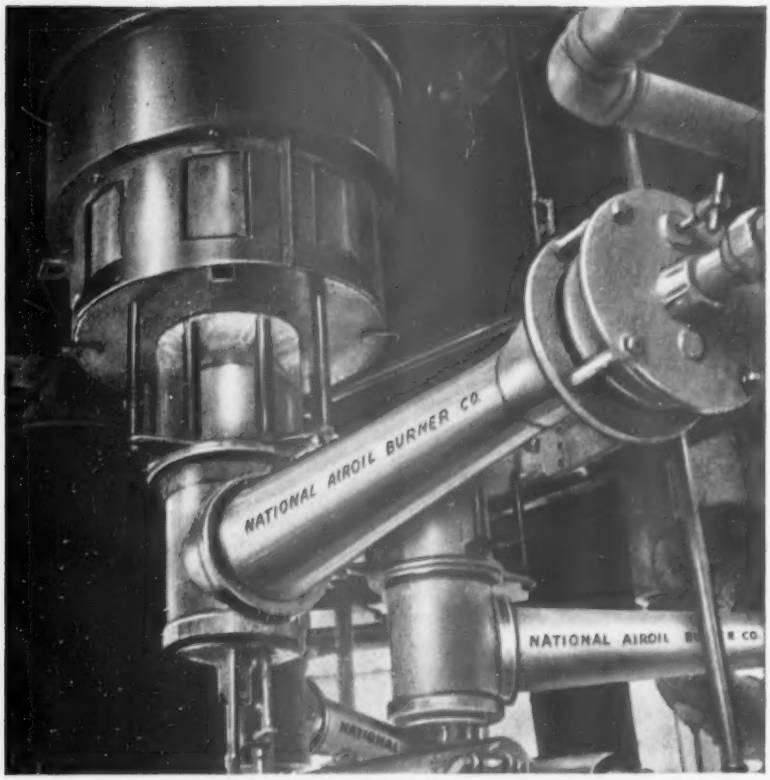

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INDUSTRIAL OIL BURNERS, GAS BURNERS, FURNACE EQUIPMENT

March or April, according to Mowdy.

Mowdy said delay in getting technical equipment has forced postponement in putting the refinery on stream.

The refinery, designed for eventual expansion to 5,000 bbl. per day using conventional processing units plus a Catforming unit, is being built by Koch Engineering Co., Inc., Wichita, Kans.

New Reformer Scheduled For Operation by July 1

TULSA.—Mid-Continent Petroleum Corp. expects its new 7,500-bbl. catalytic reformer at its 60,000-bbl. West Tulsa refinery to be ready for operation by July 1.

Construction was started last September and is progressing satisfactorily, according to G. E. Wynn, vice president in charge of manufacturing.

The unit, licensed by Atlantic Refining Co., was designed by W. M. Kellogg Co. and is being built by Mid-Continent.

Wynn said expansion of a 1,700-bbl. alkylation unit to 2,200 bbl. per day is scheduled to begin in midsummer, with completion in late fall.

Great Northern Oil Co.'s Refinery Site Purchased

ST. PAUL.—Great Northern Oil Co. has purchased 950 acres of land along the Mississippi River and the Chicago Great Western Railway about midway between here and Hastings for the construction of a 20,000 to 25,000-bbl. per day refinery.

William J. Carthaus, president of the newly organized company, said Lummus Co. has been awarded the contract for preliminary engineering on the refinery. The refinery will process Saskatchewan crude from Fosterton field.

Petrochemicals

Brea Plans Nitric Acid, Ammonium Nitrate Plant

LOS ANGELES.—Brea Chemicals, Inc., subsidiary of Union Oil Co. of California, has awarded a contract to C. F. Braun & Co. for the engineering on a new nitric acid and ammonium nitrate plant.

The proposed plant, estimated to cost about $2,500,000, will be located adjacent to the $13,000,000 ammonia plant now under construction at Brea, Calif., for Amoniaco Corp. and which will be leased and operated by Brea.

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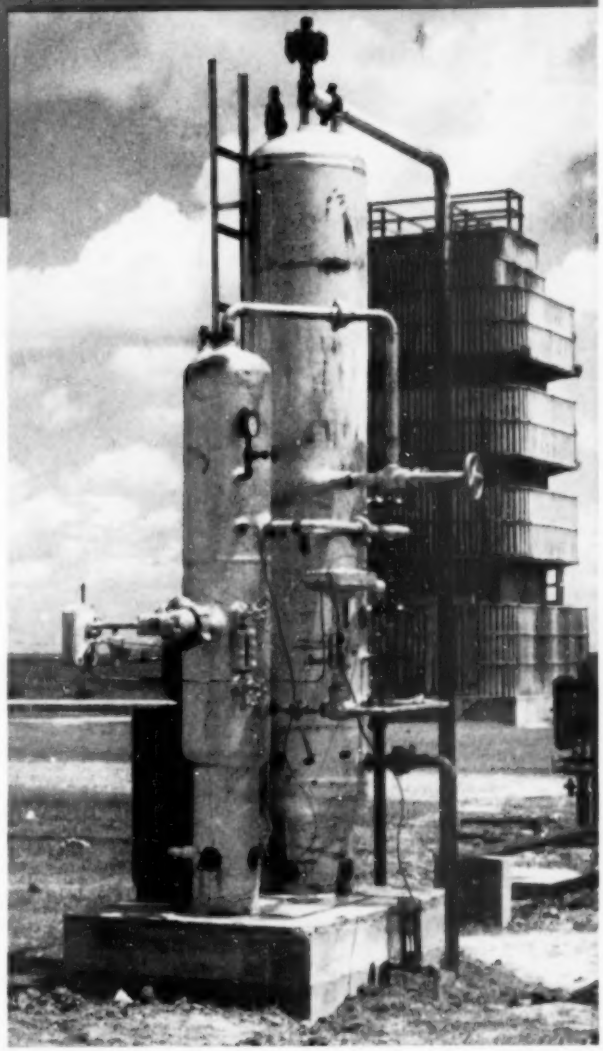

Maloney-Crawford's Verticold is a simplified cold separation unit with only two controls, thus minimizing costly maintenance and shut-down time. Verticold has proven effective in field tests raising recovery from 41.15 barrels MMCF to 50.21 barrels MMCF. For details call a Maloney-Crawford representative or write.

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NATURAL GAS

Future Gas Supply

Reserves in excess of 500 trillion cubic feet seen

NEW YORK.—Future supply of natural gas of the United States considerably in excess of 500 trillion cubic feet was predicted by Lyon F. Terry, vice president of Chase National Bank here, before the annual meeting of the National Federation of Financial Analysts Societies.

He said that in 1950, before the American Gas Association, he had estimated conservatively that the total recoverable gas supply would eventually exceed 500 trillion cubic feet. "Re-examination of the future supply from the standpoint of geological potentialities leads me to the conviction that the old estimate was very conservative," he said.

Production rise . . . He also predicted that production of natural gas may readily grow to 12 to 14 trillion cubic feet by 1956, compared with 8.64 trillion in 1952, and 6.25 trillion for 1949.

Terry cited the decrease in the ratio of proved reserves to annual production and predicted the continuation of that decrease. However, he said this should not cause concern as long as additions to reserves substantially exceed production. He said an average of 1.95 cu. ft. of gas was added to known reserves for each cubic foot of gas produced during 1948-52.

In describing the gas industry outlook, he said consideration should be given to:

. . . Increasing supplies supporting further expansion of the gas markets.

. . . Continued competition causing further rapid growth of the gas industry.

. . . Eventual substantial rises in field prices of gas, reducing the advantage of gas over other fuels.

. . . Failure of rising prices to greatly affect sales to residential consumers.

. . . Continued advance in use of natural gas for space heating.

. . . A gradual slackening in the growth of the gas utility industry, but no decrease in future potentials of the industry.

At the same meeting, A. W. Conover, president of Equitable Gas Co., Pittsburgh, Pa., told the securities analysts, ". . . Gas in storage represents a big and growing investment . . . there are more than 150 major storage fields in the nation, with many more under construction. The total investment in these fields, including gas and the facilities to deliver large quantities of it to customers quickly, is $264,000,000. It is estimated that another $134,000,000 will be invested in storage during the next 4 years."

Plans Changed

El Paso Natural revamps Spraberry compressor plans

EL PASO, Tex.—El Paso Natural Gas Co. has revamped its plans for construction of facilities to handle casing-head gas from Spraberry Trend area field in the West Texas Permian basin to achieve a more-efficient over-all operation with smaller construction and operating costs.

The current plan involves a big change in compressor capacity and in absorption, dehydration, and purification facilities at El Paso's new Pembrook, Driver, and Midkiff plants in the Spraberry area. However, the total capacity will remain roughly the same.

Capacity changes . . . Compressor capacity of the company's Pembrook and Driver stations will be cut a total of 22,700 hp. under that originally planned—the Pembrook station from 18,000 to 8,100 hp. and the Driver station from 38,800 to 26,000 hp. The Midkiff plant's compressor capacity, meanwhile, will be increased from the originally planned 20,880 hp. to 44,640.

The first two stations now will be used for first and second-stage compression of Spraberry gas. At Midkiff, El Paso will process the gas, compress it further, and deliver it to Permian Basin Pipe Line Co.'s system for delivery at El Paso's station at Plains in Yoakum County *(see story in Pipe Line section)*.

All absorption, purification, and dehydration facilities will be concentrated at Midkiff, rather than scattered at all three plants as originally planned. Planned dehydration-purification capacity at Midkiff has been increased from 65,750,000 cu. ft. of gas a day to 250,000,000.

Liquids output . . . It is anticipated that the Midkiff gasoline plant will produce about 200,000 gal. of propane, 150,000 gal. of butane, and about 126,720 gal. of 12 lb. R.v.p. natural gasoline per day under capacity operation.

The compressor construction work, an El Paso official said last week, should be completed by March 1. Installation of purification, dehydration, and absorption facilities should be entirely completed by November 1.

Hearings on Facilities for Colorado Interstate Set

WASHINGTON.—Hearings on applications by Colorado Interstate Gas Co. and Natural Gas Pipeline Co. of America for additional natural-gas facilities have been scheduled for February 24 by the Federal Power Commission.

Colorado Interstate proposes to build facilities costing $3,999,703 to enable it to deliver about 20,000,000 cu. ft. of gas per day to Natural Gas Pipeline. Natural Gas Pipeline proposes to build $665,000 of facilities in Morton County, Kansas, to receive the additional gas.

Natural Gasoline

Construction Started On New Gas Cycling Plant

HOUSTON, Tex.—Piling is being driven at the construction site of a new $10,000,000 cycling plant in St. Landry Parish, Louisiana, to process gas from the newly unitized Krotz Springs gas-condensate field.

Gulf Refining Co. is building and will operate the new facilities, which will be jointly owned with Humble Oil & Refining Co. and The Texas Co. *(The Oil and Gas Journal, December 14, page 191)*. The plant will recover 27,500,000 bbl. of condensate, butane, and propane from Krotz Springs field.

The facilities are expected to be put into operation by the middle of 1955.

Ethanolamine Prices Cut By Union Carbide Co.

NEW YORK.—Carbide and Carbon Chemicals Division of Union Carbide Co. has announced reductions of 1½ cents per pound in the three ethanolamines.

New prices in tank-car and carload lots respectively are 26½ and 28½ cents per pound for monoethanolamine, 26 and 27¾ cents per pound for diethanolamine, and 23 and 24¾ cents per pound for triethanolamine.

Among the Drilling Contractors

New Drilling Company Supplants Lomax Firm

Lomax Brothers Drilling Co., Midland, Tex., a partnership of Pete and Paul Lomax, has been dissolved after 6 years of drilling operations in the Permian basin of West Texas and Southeast New Mexico. Pete Lomax purchased Paul's interest in the partnership and will operate as Pete Lomax Drilling Co., Inc. This firm has three rigs in the Permian basin.

Officers of the new company are: Pete Lomax, president; J. M. Reeves, former drilling superintendent for Lomax Brothers, vice president; and Murphy Baxter, Midland independent oil operator, secretary-treasurer.

Casey & Montgomery tools will be used on Universal Consolidated Oil Co.'s projected semiwildcat test, 1 Oliver, in the Edison area, of Kern County, California. Location is in 8-30-29.

Miller & York, Bakersfield, Calif., will drill Standard Oil Co. of California's first test in McLure Valley, Kern County, California. The test, 1 Avenal, a wildcat, is located in 13-24-17, approximately 3 miles northwest of Reserve Oil & Gas Co.'s recently completed oil-discovery well.

H. L. Rowley, Inc., Shreveport, is drilling for Paul F. Barnhart and J. Ray McDermott at 1 Teas et al, a newly started wildcat test in the Melville area, St. Landry Parish, southern Louisiana. Location is in 25-4s-6e.

Worley & Harrell, Inc. Tulsa

WORLEY & HARRELL, Inc., Tulsa, is one of the pioneer drilling contracting firms in the North Dakota sector of the Williston basin. It has been active in that area since December 1951, almost from the inception of the Williston basin play, and now is in its third winter there.

The company, organized in September 1951, has its headquarters in the National Bank of Tulsa Building, at Tulsa. Field office and yards for its North Dakota operations are located at Williston.

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Organization . . . Officers include Loyd F. Worley, Tulsa, president; Burrel

Portable, truck-mounted rotary rig operated by W. C. Taggart, Big Rapids, Mich., drilling contractor, in development of the recently discovered shallow producing area near Clinton, in Washtenaw County, southeastern Michigan. Equipped with Wilson draw works and Wilson-Snyder and Wheland mud pumps, powered by GM Series 71 diesel engines, it put down the 1,100 ft. discovery well in less than 8 days. It is one of two rigs being used by Taggart in the immediate area.

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Harrell, headquartering at Williston, vice president and general drilling superintendent; and Paul R. Peterson, Tulsa, secretary-treasurer. Tool pushers are: Elgin F. Burns and George H. Zier, Williston and Tioga, N. D., respectively. All have been with the company since its inception.

Worley has been active in the oil business as a producer and contractor since 1940.

Harrell has worked in oil fields for more than 20 years, starting as a roughneck in California. He was employed by Superior Oil Co. of California for 11 years, working up to become tool pusher the last 5 years with that company. He then went with Fred M. Manning, Denver, becoming general drilling superintendent for that contractor for 2½ years with 28 rigs under his immediate supervision in the Rocky Mountain area, southern Oklahoma, and West Texas.

Peterson has been associated with the oil business since 1936 in various capacities.

Burns has had more than 15 years' experience as a driller and tool pusher with the distinction of having drilled on Superior Oil Co.'s 20,000-ft. ex-depth-record test in southwestern Wyoming. Zier has worked successively as a roughneck, driller, and tool pusher for the past 8 years.

Equipment . . . Two rotary rigs, both capable of drilling to 13,000 ft. with 4½-in. drill pipe, are being operated. Starting with one rig, purchased in November 1951, the company acquired its second rig in October 1952. The rigs are identical, each including a National 80 draw works, a C-350 pump, a C-250 pump, and three Superior 6G-510 gas-butane engines, each developing 345 hp., or a total of 1,035 hp. They are provided with 133-ft. Lee C. Moore masts with 12-ft. substructures.

Operations . . . Drilling has been confined largely to Beaver Lodge and Tioga fields of Williams and McKenzie counties. In these fields, the company has drilled approximately 260,000 ft. of hole to date, and soon will be on its thirty-first well.

Appling Drilling Co., El Campo, Tex., has contracted for a 7,000-ft. test to be drilled for T. J. Ahern and associates, of Houston, at a wildcat location 3 miles southeast of Ganado, in eastern Jackson County, Texas Gulf Coast. Location is for 1 Burns, in the W. D. Sutherland Survey.

McConnell Drilling Co. is contractor on an 8,000-ft. wildcat test Byrd Oil Co. and R. E. Smith are starting in the Samuel Jones Survey, 1½ miles east of Hanover, in Milam County, Southwest Texas. Location of the test, 1 Henderson, is about 1½ miles northwest of a gas-discovery well completed by Byrd Oil Co. last summer.

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ACTIVE ROTARY RIGS*

Area—	Week ended 2-8-54	Change week ended 2-1-54	Change week ended 2-9-53
Gulf Coast	508	— 6	—106
N. & W. Tex.-N. M.	781	+13	— 36
Ark.-N. La.-E. Tex.	163	+10	+ 38
Oklahoma	388	+30	+ 68
Kansas-S. Nebraska	146	— 1	— 37
Illinois-Eastern	117	+14	+ 8
Rocky Mountain	249	—11	+ 46
Pacific Coast	152	— 6	— 13
Total U. S.	2,504	+43	— 32
Western Canada	148	+12	+ 5
Total	2,652	+55	— 27

*Courtesy Hughes Tool Co. Trends in drilling activity in the United States, and the Gulf Coast and Arkansas-North Louisiana-East Texas areas are shown on pages 237 and 238.

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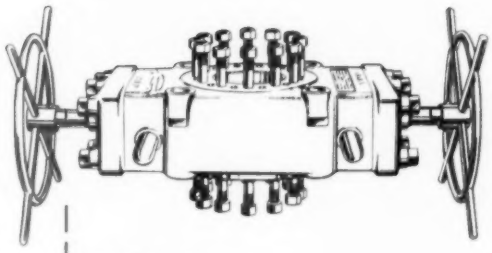

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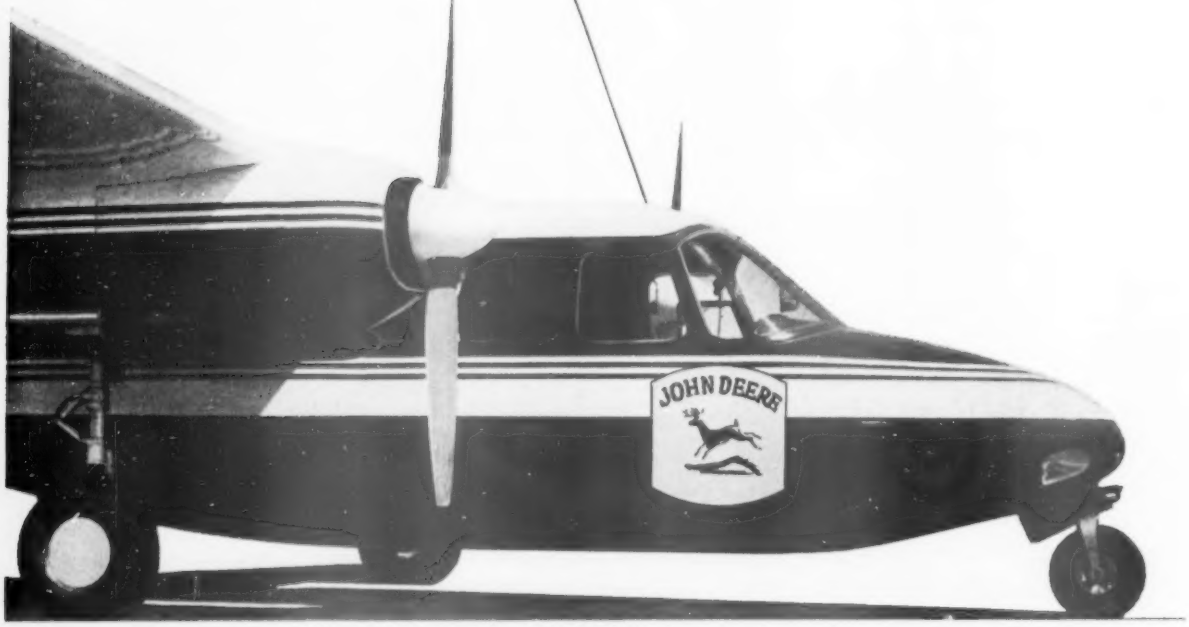

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EXPLORATION

Devonian Production Forges Northward

by Frank J. Gardner

SILURO-DEVONIAN production is pushing slowly to the north in Roosevelt County, New Mexico, as Amerada Petroleum Corp. forges another link in the arcuate chain of fields along the northwestern shelf of the Permian basin.

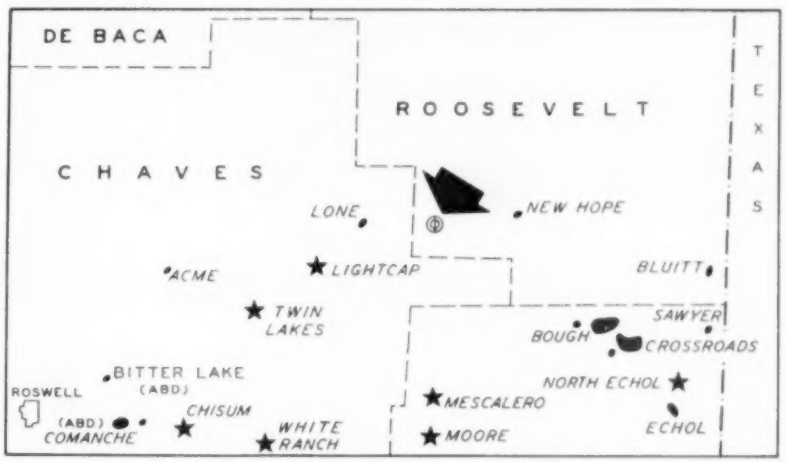
Sixteen miles northeast of Lightcap (Devonian) field and 27 miles northwest of Crossroads (Devonian) field, Amerada's 1 Federal "C" has found flowing oil in the Siluro-Devonian dolomite at 9,200-9,300 ft., about 1,200 ft. deeper than Lightcap pay and 2,900 ft. shallower than Crossroads. Tentatively, the name of Squires field is applied to the new discovery.

A glance at the stars on the map, beginning at Chisum field in the lower left corner and climbing northeast to the new strike (arrow on map) emphasizes the pattern of events to date in defining the limits of the northwestern Permian basin shelf in this region.

Progressively, during 1950, Chisum, Lightcap, and Twin Lakes fields were discovered at respective producing depths of 6,500, 7,950, and 7,250 ft. Was it a coincidence that the flowing potentials of the three strikes increased in direct proportion to the depth of Devonian pay? Some observers thought not, and the conclusion rapidly became apparent that here the drill was beginning to define the shore-line pinchout of the Devonian rocks on the northwestern shelf of the basin.

The three 1950 discoveries were obviously located near this old shore limit, for the productive reservoir rock displayed definite near-shore characteristics; at Crossroads, the Devonian pay rock was, on the other hand, a more porous dolomite of offshore character.

Immediately it was evident that the vast sweep of relatively unexplored territory between Chisum-Twin Lakes-Lightcap on the west, and Crossroads on the east was fair game for the operator in search of Devonian pay. To spot suitable structures was the problem; seismic work is difficult in the area, for Devonian structures are not readily reflected by Permo-Pennsylvanian seismograph pictures, which are themselves hard to obtain. But reflection seismograph work in the three-county area showed a remarkable 50 to 60 per cent increase over 1950 during 1951 and 1952, as geophysicists searched for likely prospects.



Producing fields of the northwestern shelf area, New Mexico. Stars indicate Devonian and Siluro-Devonian production; arrow points to Amerada's new Devonian strike, 1 Federal "C."

Close coordination of seismic pictures and subsurface geologic findings resulted in the blocking of several promising localities, and early in 1952, The Texas Co. drilled its 1 J. H. Moore to 10,471 ft. in northwestern Lea County and completed it as one of the best Devonian wells yet recorded. This was the discovery well of Moore field, with a flowing potential of 2,904 bbl. per day from Devonian dolomite topped at 10,375 ft.

Mescalero Discovery

Six months later and 6 miles due north of Moore field, Cities Service Oil Co. discovered Mescalero field at its 1 State AD, another flush producer from Devonian dolomite at 9,800 ft., with a potential of 2,174 bbl. per day.

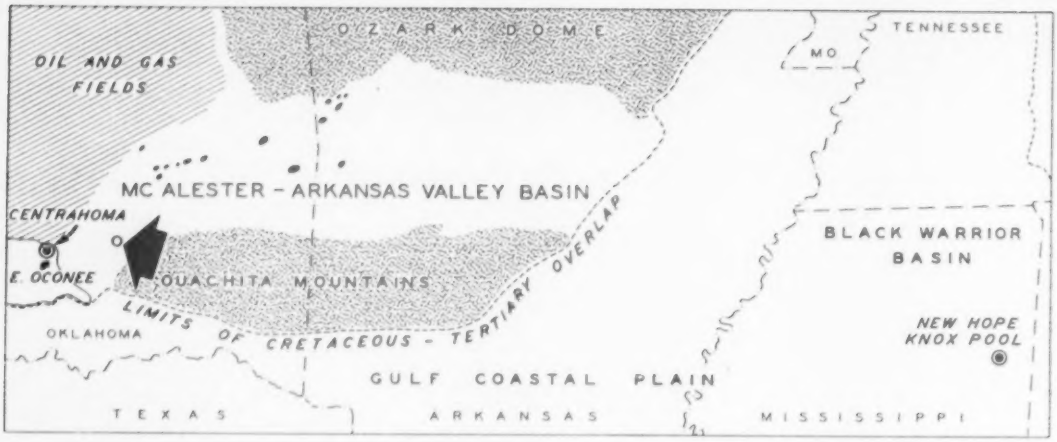
Between the Moore-Mescalero basinward fields and the near-shore Chisum-Twin Lakes-Lightcap trend, Republic Natural Gas Co. and Seaboard Oil Co. proved production in 1953 at White Ranch field, finding Devonian oil at 8,750 ft.

A new look at the map of these Devonian fields is certainly in order now; production has been established to the northwest, to the east, in the center, and in the southwest. Between the stars on this map, approximately half a million acres lie relatively unexplored by drilling. Definition of the northern limits is materializing, but to the northeast, there is much to be learned about the position of the shelf. Crossroads field, producing from 12,106 ft., would not seem to fall within the near-shore classification; its discovery well was the largest Devonian producer to date (3,744 bbl. per day).

What lies to the east and northeast? Slowly the pieces of this Paleozoic puzzle are beginning to fall into place, but before the picture is complete, new tests must go down in southeastern Roosevelt County, New Mexico, and Cochran County, Texas.

The new Amerada strike will shed essential light on the northern extent of this prolific Devonian basin; the operators are continuing to drill and core the section in order to determine its thickness and lithology. Indications are that the new field may lie within the limits of basin phase facies, but not more than 8 to 10 miles south of the point of Devonian pinchout on the pre-Cambrian basement rocks.

The significance of this discovery is in its role of probing finger, a subsurface tentacle groping carefully but not blindly up and out along the basin floor in a search for the northern limits of the old Devonian shore.



Arrow points to Southwest Exploration Co.'s important stratigraphic test to be drilled in Pittsburg County, southeastern Oklahoma.

New Oil Province for Oklahoma?

by John C. McCaslin

A STRATIGRAPHIC test which may shed new light on the theory that a new oil province possibly lies beneath the overthrust Ouachita facies of the McAlester-Arkansas Valley basin has been announced for Pittsburg County, Oklahoma, by Southwest Exploration Co. (Arrow on map).

The 1 Hoehman will be drilled in C NE SE 16-2n-14e, about 8 miles southeast of Kiowa. It is projected to a depth of 10,000 ft. plus, and is located in the area of southeastern Oklahoma where the overlying Ouachita facies are thought to have been thrust over underlying Arbuckle facies. The region of overthrusting is believed to cover several thousand square miles. No wells have definitely drilled through the overthrust to explore the Arbuckle facies beneath.

If a full Arbuckle section proves to be present below the overthrust, this would include reservoir rocks that have proved very productive in the Seminole platform in Oklahoma. These reservoirs include the Wilcox, Tulip Creek, McLish, and Oil Creek sands of the Simpson series, as well as the Hunton and Viola limes.

There also is the possibility of finding production in the overlying facies in which there are two producing pools at the present time in the area. Oil seeps have been seen in this region for years, giving encouragement to the theory that production might be found beneath the overthrust.

The area of oil possibilities in the McAlester-Arkansas Valley basin includes about 21,000 sq. miles of southeastern Oklahoma and northwestern Arkansas. Sediments in the basin range in thickness from 2,000 to 40,000 ft. A near complete section of lower Paleozoic rocks ranging from Upper Cambrian through Mississippian with numerous unconformities and local overlaps is found in the northern and northwestern part of the basin.

The Arbuckle-Ozark type beds are more likely to have accumulated oil than the Ouachita facies. The Ouachita facies in general have low porosities and varying degrees of metamorphism and lack an abundance of organic remains. The Ouachita facies is made up of clay shales, sandy shales, novaculites, cherts, and some sand. However, the Arbuckle facies is composed of rocks similar to those producing in Oklahoma's Seminole area and other Mid-Continent fields.

Pennsylvanian rocks in the basin attain great thicknesses. Coal beds are numerous and there are more than 60 dry-gas fields in the upper part in anticlinal or fault-trap structures. Additional gas production may be expected in the Pennsylvanian rocks. There is a facies change in the pre-Atoka rocks of the basin. The rocks in the Ouachita Mountains are continental, near-shore clastics, while in the Ozark uplift region, they are marine limestones, dolomites, and shales. It is believed that the Cambrian and Ordovician rocks in the basin undergo no major change in facies, and it is in these rocks that oil production has been established.

Ouachita Mountains . . . The Ouachita Mountains are about 50 to 60 miles wide, extending eastward from Atoka County, Oklahoma, into Arkansas. This is only a part of the chain as the southern and eastern flanks are buried by the Cretaceous-Tertiary overlap of the Gulf Coastal Plains. The thickness of the Cambrian through Devonian in the mountains is about 3,000 ft., while the early Pennsylvanian is about 17,000 ft. The Atoka is even greater in thickness. There are five thrust sheets in the Ouachita Mountains A zone of open folds, which gradually decrease in intensity northward, lies in front of the thrust sheets. These gradually decreasing folds are part of the foreland and make up the McAlester-Arkansas Valley basin.

Nowhere in the Ouachitas are the pre-Cambrian rocks exposed on the surface, nor have they ever been reached by the drill. The older Paleozoics in the area were deposited during quiet geologic periods, while the younger part was laid down during a period of considerable activity. Ouachita folds are traced from their outcrops in the Ouachita Mountains across the Mississippi embayment into central Mississippi.

Early Paleozoic oil production has been established at both ends of the long basin; in Coal County, Oklahoma, and in Monroe County, Mississippi. Since 1952, good oil and gas-distillate production has been developed in the Simpson sands at East Oconee and Northwest Tupelo fields in Coal County, Oklahoma. A deep test in Centrahoma pool, Coal County, heretofore a small Pennsylvanian sand producer, is

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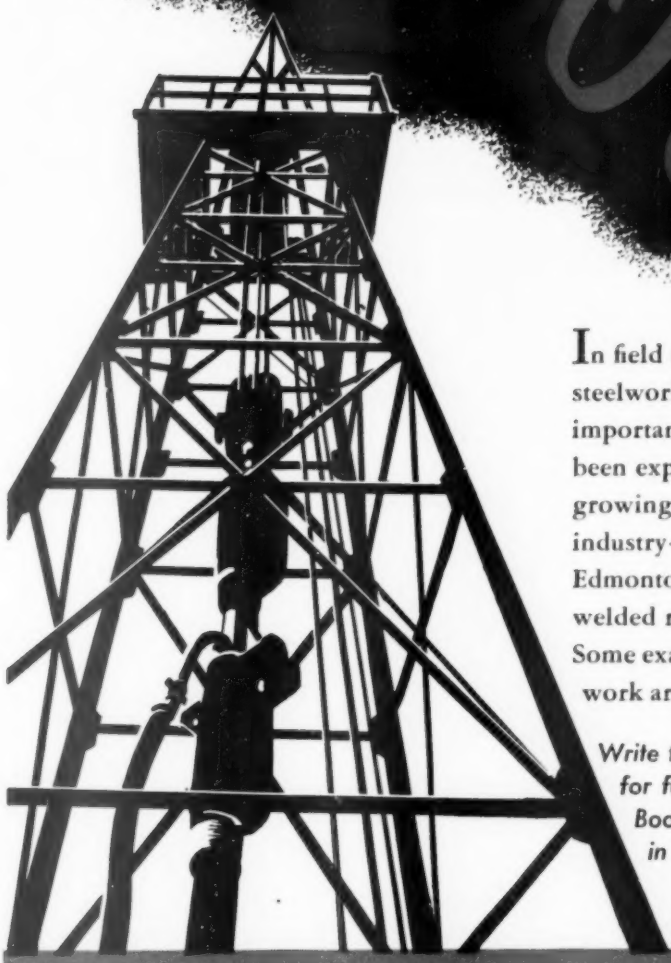

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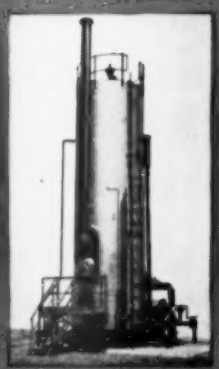

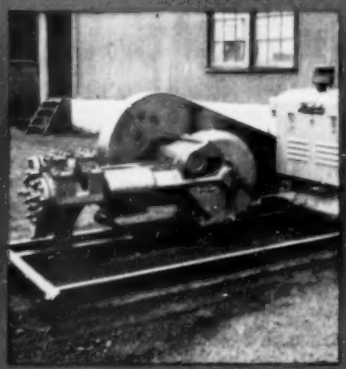

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the most recent success in the heavily faulted area. Twin Oil Corp. 1 Cody flowed oil at the rate of 500 bbl. per day from the Simpson-Oil Creek sand at 6,882-92 ft. Good pay in the Bromide and McLish sands was established at Northwest Tupelo field last year. The discovery well in the significant pool flowed 220 bbl. of oil daily from the Bromide sand. This well in Centrahoma pool was one of the best wells ever completed in southeastern Oklahoma.

Magnolia Petroleum Co. opened Cambro-Ordovician production in Mississippi at 1-A Snow in the Black Warrior basin, the elbow between the east-west-trending McAlester-Arkansas Valley basin and the roughly north-south-trending Appalachian basin. This discovery is generally regarded as one of the most important in recent years in the southeastern states. It flowed oil at the rate of 29 bbl. per hour from the Knox dolomite of the Lower Ordovician-Upper Cambrian. The Knox dolomite is the approximate equivalent of the prolific Ellenburger of West Texas and the Arbuckle of the Mid-Continent area. The discovery marks the first production of any kind in the Black Warrior basin from pre-Mississippian rocks, or elsewhere in Mississippi from formations below the younger Cretaceous.

References

P. C. Ingalls, "Will the Arkansas Valley Yield Oil?", The Oil and Gas Journal, September 28, 1953, p. 179.

A. J. Eardley, "Structural Geology of North America"

Neil Williams, "New Oil Basin", The Oil and Gas Journal, September 7, 1953.

"Possible Future Petroleum Provinces of North America", A.A.P.G., 1951.

New Showing in Williston Basin

SOCONY-VACUUM OIL CO., INC., has recovered the first showing from the Otter formation (Mississippian) in the Williston basin.

A slight showing of oil and gas was recovered in a sample cut from the Otter at the company's Teepee Buttes area wildcat in southwestern North Dakota's Hettinger County. The show was encountered at 6,980 ft. The operator is coring the section.

The Otter formation is in the Mississippian Big Snowy group. The Heath sand, which lies just above the Otter, was topped at 6,715 ft. Oil has been recovered from the Heath sand in North Dakota, but to date no wells have been completed in this formation in that area. However, Heath sand production is found in Central Montana's Sumatra area. The only other sand in the Williston basin found to be oil bearing is the Triassic-Spearfish in Bottineau County, northeastern North Dakota, where it overlies the beveled edges of the Mississippian limestone, the basin's leading pay zone.

A sequence of more than 1,000 ft. of limestone, shale, and sandstone of Mississippian age in Central Montana has been subdivided into the Kibbey sand, Otter formation, and Heath shale, making up the Big Snowy group. The Heath in Central Montana is characterized by thick sequences of black shale with thin beds of limestone, dolomite, anhydrite, siltstone, and sandstone, becoming thick locally. The Heath is conformably overlain by the lower member of the Amsden (Upper Mississippian) formation and is transitional upward into it. The Heath is transitional downward into the Otter formation. Oil was first discovered in the Heath in 1919.

Heath indications . . . In the Fryburg area of Billings County, North Dakota, Amerada Petroleum Corp.'s 1 Logan, a northwest offset to the Madison (Mississippian) discovery, recovered more than 1,200 ft. of black oil from the Heath. This was the first well in North Dakota to recover oil from the Heath.

Amerada also recovered oil from the Heath on drill-stem test at the 1 Franchuk in the Fryburg area to become the second well in this pool to have indicated commercial production in this formation. Recovery at this well was 2,114 ft. of black oil on drill-stem tests. At the Amerada 1 Logan the Heath sand was only 15 ft. thick. If the Heath's thickness is found to be as variable as it is at Beaver Lodge field, where it ranges from a few feet to 100 ft. between locations, it is possible that the sand may prove commercial eventually in the Fryburg area.

No Heath showings have been found in the Cedar Creek anticline area of Montana, but two East Poplar field wells reported Heath recoveries in Roosevelt County.

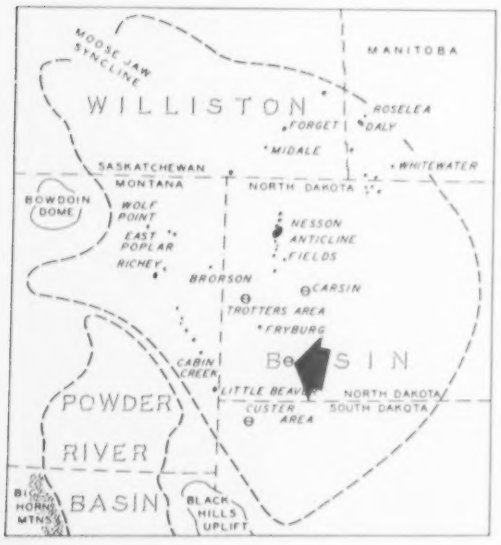

Fig. 1—Socony-Vacuum Oil Co.'s Teepee Buttes wildcat in Hettinger County, southwestern North Dakota, is arrowed on map of the Williston basin. This wildcat recovered oil shows in the Otter formation (Mississippian), the basin's first such showing.

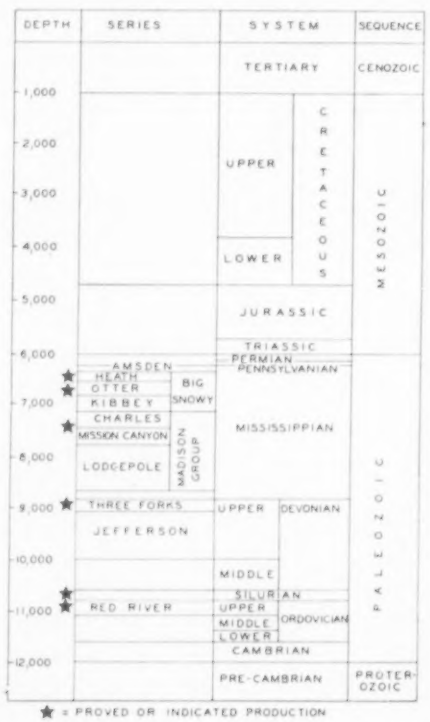

Fig. 2—Williston basin formational sequences are shown on this generalized stratigraphic section which shows graphic and tabular relationships of sediments from the pre-Cambrian through the Tertiary. Stars shown at left of graphic column indicate current proved or indicated producing formations.

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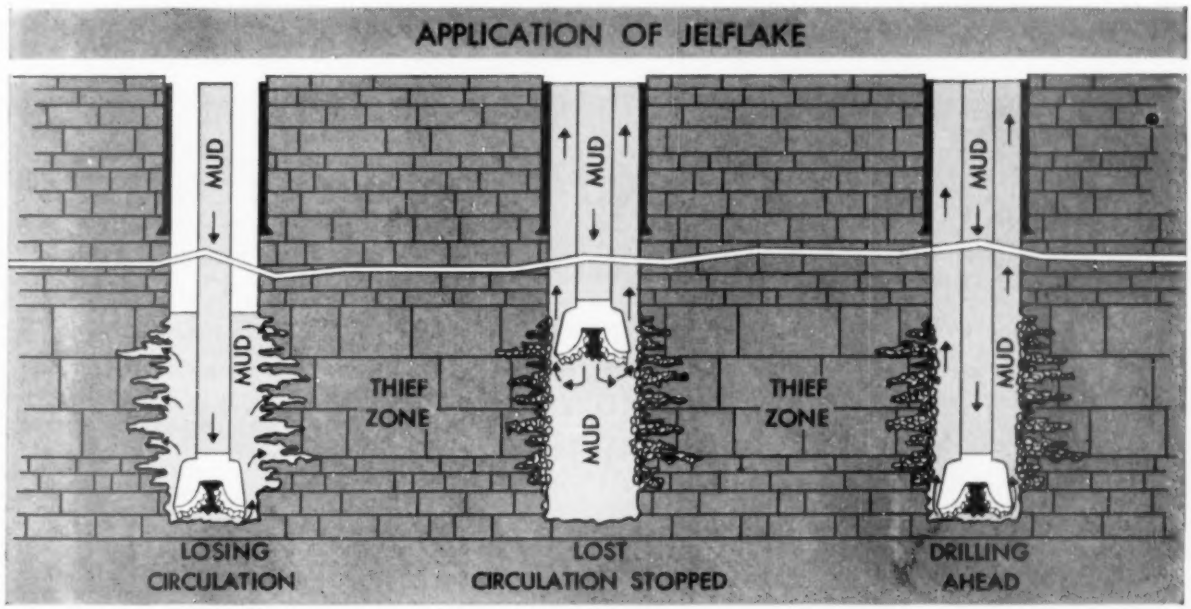

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OKLAHOMA

West Mount Vernon Pool Gets Its Second Well

Jernigan & Morgan 1 Smiser, SE SE SE 5-15n-3e, Lincoln County, is the second well in new West Mount Vernon pool.

After fracture treatment the well flowed 50 bbl. of load oil per hour. It later flowed 15 bbl. of new oil hourly for 6 hours on ¼-in. choke. Testing continues at the well. This confirmation well is the north offset to the field discovery well, the 1 Starling, which was completed last fall for 25 bbl. per day. The field opener's southeast offset well was dry. The east offset, Globe Oil & Refining Co. 1 Pritchett, offsetting the 1 Smiser, is drilling below 2,850 ft. in SW SW SW 4-15n-3e.

Production Tests Being Set Up at Washita Wildcat

Gulf Oil Corp. is completing preparations for production tests at its 1 Goeringer in western Oklahoma's Washita County in NE SE 28-11n-16w. Total depth is 12,559 ft. The liner is perforated at 12,229-366 ft., 12,390-400 ft., and 12,414-455 ft.

Misener Outpost is Finaled in Garfield

Carter Oil Co. is completing a prolific outpost well in Garfield County at 1 Sharkey, SW SE NE 29-24n-4w, 1 mile southeast of South Hunter pool, separated by a dry hole.

The well flowed 255 bbl. of 48.1°-gravity oil in 15 hours through ⅛-in. choke plus 210 M.c.f. of gas per day. Previously the well flowed 34 bbl. of load oil, then 186 bbl. of new oil in 19 hours through ¼-in. choke from the Misener sand through perforations at 6,149-54 ft.

First 24-Hour Production Test Made at Washita Wildcat

Gulf Oil Corp. reported the first 24-hour production test at their deep discovery in Washita County, the 1 Goeringer, C NE SE 28-11n-16w.

The well flowed 271 bbl. of oil per day on 1-in. tubing choke with 1,750 M.c.f. of gas per day, natural. The well flowed 130 bbl. of oil with 1½ per cent water, 3 per cent mud and 2 per cent basic sediment during the last 12 hours of the test.

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KANSAS

Big New Producing Area Indicated in Clark County

Eastern Clark County has a big producing area covering several sections indicated by the results of two tests of United Producing Co.

The 1 Campbell, C NW SE 32-33s-21w (arrowed on map) is flowing gas after fracture

treatment at an unannounced gage from the Morrow sand perforations at 5,392-5,402 ft. The 1 Harper in C NW SE 10-34s-21w, is also flowing from perforations at 5,464-76 ft. The pool's name is Harper Ranch pool, opened last year at United 1 Harper, C NW SE 9-34s-21w, flowing 6,000 M.c.f. of gas daily from Marmaton perforations at 5,437-69 ft. The pool is about 7 miles north of Harper County, Oklahoma.

Pawnee County Strike Made West of Oro Pool

Cities Service Oil Co. has an indicated discovery well at 1 Risse, NE NE NE 14-20s-20w, 4 miles west of Oro pool in Pawnee County.

Recovery on a drill-stem test at 4,170-87 ft. in the conglomerate was 2,140 ft. of oil.

Testing continues at Natural Gas & Oil Corp. and Republic Natural Gas Co. 1 Starke, NE NE NW 24-23s-15w, north of Green Ridge pool in southeastern Pawnee County. The discovery gaged 1,000 M.c.f.

of gas per day from perforations at 3,932-52 ft. in shaly conglomerate after acid and fracture treatment.

Good Show Recovered At Pratt Discovery

Buffalo Oil Co. and GMR Oil Co. have tested a good showing of oil in the Lansing at 1 Lion, SE SE NW 21-27s-11w, 1½ miles northeast of Lion gas pool in eastern Pratt County.

Recovery on a drill-stem test at 3,773-3,800 ft. was 1,020 ft. of gassy oil and 60 ft. drilling mud with 1,420 psi. bottom hole pressure.

NEW MEXICO

SOUTHEAST NEW MEXICO

Devonian Wildcat Has Oil Show on DST

Argo Oil Corp. 1 Tomlinson, southeast of the big Denton-Devonian field, Lea County, has made two drill-stem tests in the Devonian which recovered oil or oil-cut mud.

Top of the formation was 12,834 ft., minus 9,082 ft. First test from 12,834-12,866 ft. recovered a small amount of 42° oil, plus oil and gas-cut mud. A 3-hour test from 12,867-12,900 ft. recovered 1,893 ft. of slightly oil and gas-cut water blanket, and 2,000 ft. of slightly oil-cut salt water. Operators were running electrical surveys.

Continental Oil Co. continued testing in the Bone Springs section at 1 Bell Lake Unit. Location of the wildcat in 31-23s-34e is on the northeastern boundary of the Delaware basin.

In the upper Bone Springs the well unloaded oil from 8,735-90 ft., and corrected information on test from 10,874-10,914 ft., still in the Bone Springs, was recovery of 200 ft. of heavily oil and gas-cut water blanket, 2,300 ft. of slightly gas-cut water blanket, and 200 ft. of mud-cut water blanket.

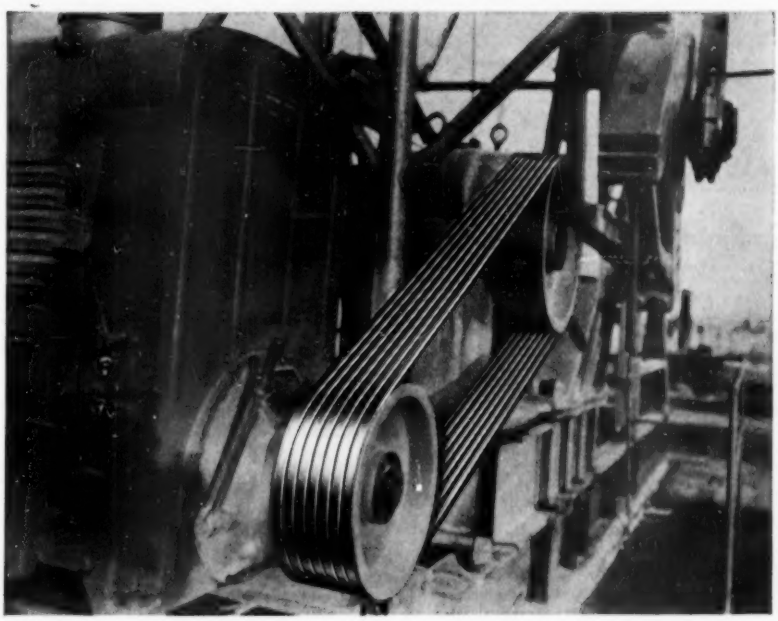
MICHIGAN

W. C. Taggart was nearing projected total depth at an older Trenton test well, where he cleaned and was deepening at the 2 Angell Schneider, et al, SE NE NW, 7-14-8e, Northville Township, Wayne County.

This first follow-up rework to his 1 LeMaster, NW SE SE 1-1s-7e, Salem Township discovery well, Washtenaw County, was being drilled in the Trenton objective at 4,405 ft., about 117 ft. below the original dry total depth of 4,288 ft. No shows had been encountered by this additional Trenton formation penetration and section was reported to be limestone, while it was found to be dolomite at the 1 LeMaster discovery well. It was expected that deepening operations would be abandoned at approximately 4,460 ft. unless pay was encountered at a lesser depth. Originally announced intentions to core the new portion of the hole at this rework were changed when clean-out encountered junk in the hole which could not be completely removed or milled up.

It was expected that rotary rework rig would be moved from the 2 Angell Schneider, et al, to another previously drilled and shallower basal Salinia-Niagaran test in the SE NW NE 2-1s-7e, where Taggart will clean out and deepen to the Trenton.

Meanwhile, the 1 LeMaster discovery well



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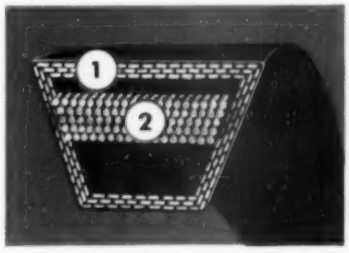

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was being flowed at a highly restricted rate of 7 bbl. of oil an hour, flowing at a steady rate. Well is being produced from a dolomite Trenton pay at 4,397 ft., total depth. It is now believed that the 1 LeMaster is bottomed out about 150 ft. in the Trenton objective.

CALIFORNIA

Caminol Completing Shallow Pyramid Hills Discovery

Caminol Co. was attempting to complete 1 Dagany as a shallow discovery in the Pyramid Hills area of Kings County. The wildcat failed to find the deeper Eocene pay uncovered by Reserve Oil & Gas Co. at the Orchard area 1¾ mile northwest. Drilled to 4,890 ft., 1 Dagany was plugged back to 890 ft. for completion in 90 ft. of Kreyenhagen sands encountered below 703 ft. Crude of about 15°-gravity was bailed from that depth.

In the Orchard area, 20-24s-18e, Reserve was preparing to drill 38-20 Orchard as a south offset to the Kreyenhagen discovery it completed in late December. The 950-ft. discovery was recorded by 37-20 Orchard after it failed to find the 4,400-ft. Eocene pay uncovered by 48-20 Orchard.

Guijarral Hills Find Being Extended

Standard Oil Co. of California 3 33F apparently has extended the one-well West Guijarral Hills field approixmately ¼ mile east. On a formation test at 8,332-55 ft. the Fresno County wildcat flowed 35°-gravity crude at an estimated 700 to 1,000 bbl. daily rate. Following the test coring was continued to 8,405 ft., where it was planned to test the 8,365-8,405 ft. interval.

The extensioner is two locations east of L. A. Harnish's Leda sand discovery in 32-20s-16e, 1½ miles west of Guijarral Hills field. The discovery was completed in October for approximately 500 bbl. daily at the producing interval of 8,351-8,410 ft. Attempts to extended production to the northwest, southwest, and southeast were failures.

Townlot Lease Play Touched Off by Fillmore Wildcat

Reported showings by Standard Oil Co. of California's deep test on the Sespe Ranch northwest of Fillmore have resulted in an extensive lease play in and around the Santa Clara Valley town.

Some 3,000 acres have been leased in recent weeks, including much of the 1,000 acres covered by Fillmore. Richfield Oil Corp., reportedly has leased more than one-third of the approximately 700 city land parcels. Anticipating townlot drilling, the city attorney's office is preparing an ordinance which will limit exploration to five islands from which wells may be slanted.

The Standard wildcat, 1 Sespe Ranch in SW SW 27-4n-20w, at last reports was redrilling below 11,600 ft. It first was drilled to 14,503 ft. and then redrilled to 14,000 ft. The current job is directed toward a better structural position so that condensate showings in the second hole can be further evaluated.

Deep Test Still Fishing

Ohio Oil Co. was making slow progress in recovering the approximately 8,000 ft. of drill pipe which remains stuck in its deep Paloma field test, the world's depth-record holder. With hole bottomed at 21,482 ft., top of the frozen drill pipe was at 13,516 ft. About 2,600 ft. of pipe has been recovered since fishing operations were undertaken last November.

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ILLINOIS

Four New Oil Pools In Illinois

Illinois operators discovered four new oil pools in January. The four new oil pools are: Posey West and New Memphis North in Clinton County, Schnell East in Richland County, and New Hebron East in Crawford County.

Boundaries of six pools were extended in January. Eldorado East was extended in Saline County, Goldengate North Consolidated in Wayne County, Iron Consolidated in White County, Sailor Springs Consolidated in Clay County, New Harmony Consolidated in Wabash County, and Clay City Consolidated had four extensions, one each in Clay, Jasper, Richland, and Wayne counties.

Seven new pays or oil-bearing strata were opened in six oil pools: the Rosiclare formation in Walpole (Hamilton County) and New Hebron (Crawford County) pools; Palestine sandstone in Eldorado East (Saline County) pool; Pennsylvanian sandstone in Epworth Consolidated (White County) and Ab Lake West (Gallatin County) pools; and Degonia and Clore sandstone in Storms Consolidated (White County) pool.

Three new pools and all 10 extensions were discovered by 13 of the 54 wildcat wells

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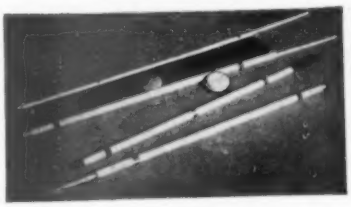

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drilled less than two miles from production. The fourth new pool was discovered by working over an old well, more than 2 miles from production, which had formerly been completed as a dry hole.

Three of the new wells completed in January were exceptionally large. Initial production from a well in the Eldorado pool was 840 bbl. flowing from the Aux Vases sandstone after fracture treatment. A well in Sailor Springs Consolidated pool flowed 1,800 bbl. from the Rosiclare formation and one in Tilden pool flowed 1,500 bbl. from the Silurian limestone.

The discovery well of the Blackland pool in Macon County, which was originally completed as a 10½-bbl. well, was fracture treated and completed with an initial production of 350 bbl. of oil.

TEXAS

TEXAS GULF COAST

14 New Coastal Fields Get Name Assignments

Official designations for 14 recently discovered fields and new reservoirs on the Texas Gulf Coast have been announced by the momenclature committee of the Houston Geological Society. The names, the county in which the reservoirs are located, and the respective discovery wells are:

Nelsonville (Mikesha sand), Austin, The Texas Co. 1 Hartman; Tynan West (4,800 ft.), Bee, Charles A. Daubert 1 Beasley; North Garwood (McDermott sand), Colorado, Ohio Oil Co. 1-T McLane Account 2; Helen Gohlke West (B-2 sand), DeWitt, Stanolind Oil & Gas Co. 5-T Bialek; League City North (Ross sand), Galveston, Gulf Coast Leaseholds, Inc., 1 Ross Unit.

Jimmie Owen (Second Yegua sand), Hardin, J. P. Owen 1-T Gore; Huffsmith (Kobs sand), Harris, James E. Kemp 2 Kleppel; Fort Trinidad (Dexter Zone "A"), Houston, Woodley Petroleum Co. 3 and 5 Bruton Estate (tansferred from Fort Trinidad (Woodbine field); Fort Trinidad (Dexter Zone "B"), Houston, Woodley Petroleum Co. 2 Bruton Estate and 3 Seven J Stock Farm, Inc. (transferred from Fort Trinidad Woodbine field); Buna North (Yegua 6 sand), Jasper, American Republics Corp. and Houston Oil Co. 2 Johnson fee (transferred from North Buna field); North Buna (Yegua 7 sand), Houston, six wells transferred from North Buna field; North Buna (Yegua 7-A sand), Jasper, Ada Oil Co. 3 Hardy Richardson (transferred from North Buna field).

Clayton (Queen City sand), Live Oak, Herring & Grimes 1 Great Southern; Louise North (Dudson sand), Wharton, Theo Hamm Brewing Co. 1 Koch Estate.

Deeper Pay Zone Opened In West Saratoga Field

Discovery of another producing horizon, the deepest so far, in the new development on the west flank of Saratoga Dome, in Hardin County, has been made by M. T. Halbouty at his 1 Skaggs, now testing sand at 8,033-51 ft.

During a 6-hour test on 10/64-in. choke, the well flowed at the rate of 247 bbl. of oil daily with pressure of 950 psi. Location is in Block 8, Saratoga-Batson Subdivision.

The area, designated as West Saratoga field, was discovered last August by Halbouty with production from a 5,800-ft. Yegua sand. Since discovery, production has been

To the many friends, associates and clients of Edgar Tobin, we extend our sincere appreciation for your messages and expressions of sympathy at his loss.

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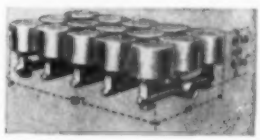

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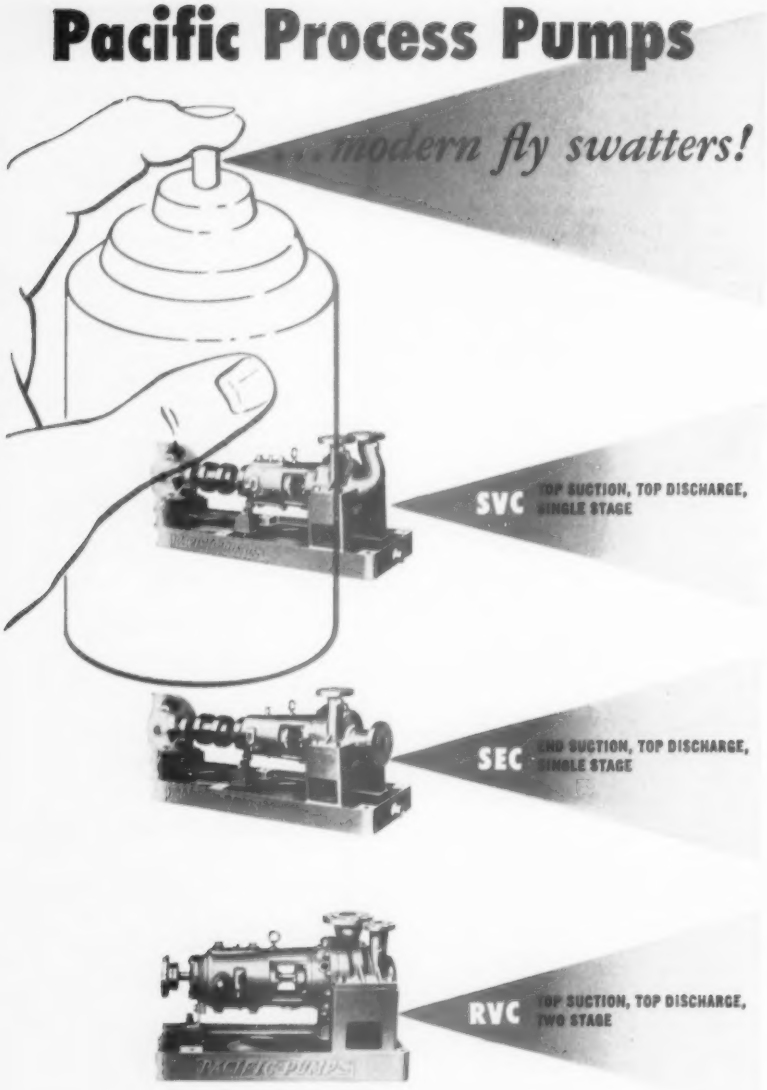

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opened in sands at 6,600 ft., 7,100 ft., and 7,400 ft. Six wells have been completed. Four others are drilling.

SOUTHWEST TEXAS

New Medina County Tests To Explore Deeper Zones

Two relatively deep exploratory tests are getting under way in Medina County, where previous exploration and development has been mainly to shallow horizons, mostly under 1,000 ft.

F. William Carr, Corpus Christi operator, is drilling a projected 6,000-ft. test, 1 Conring, in Section 748, William Ritchie Survey, 7 miles south of D'Hannis, in the southwestern part of the county, a rank wildcat area.

Location of the other test, being drilled by W. L. Hinds, of Fort Worth, at 1 Briscoe, in J. Schmerher Survey 5¼, is in the southeastern corner of the county, 2½ miles southeast of Natalia. It is a short distance north of old shallow production in Bear Creek field.

Queen City Production Confirmed at Clayton

Recent discovery of oil production in Queen City sand in Clayton field, 7½ miles west of George West, in western Live Oak County, has been confirmed by completion of the second well in the pay.

The new producer, Herring & Grimes Oil & Gas Co. 1-B Great Southern, flowed 70.38 bbl. of 43°-gravity oil per day through 5/32-in. choke with 240-psi. pressure and gas-liquid ratio of 342 cu. ft. per barrel.

Pay is perforated at 5,106½-09½ ft. in hole drilled to 5,110½ ft. Discovery well, same operators' 1 Great Southern, flowed 116 bbl. per day from interval at 5,123-26 ft.

Except for these two wells, production in the field is gas-condensate from Wilcox sands.

WEST TEXAS

Glasco Offset Flows Devonian Oil

Cities Service Oil Co. 1 Butler, in northeast Andrews County, has added a little encouragement to the new Glasco-Devonian pool, where offsets have run low structurally and prospects of a second producer have been poor.

Cities Service 1 Butler is a northwest offset to the discovery. Formation tops, above the Devonian ran low, but tentative sample top on the Devonian placed it about flat with the discovery, and field sources reported samples from the Devonian to be comparable with the discovery well. On a drill-stem test at 12,545-12,565 ft., oil surfaced in 1 hour and 20 minutes, which was turned into pits for 10 minutes, then into tanks where it gaged 118.5 bbl. of oil in 3 hours. Operators were running electrical surveys before making completion.

Plymouth Oil Co. 1 Butler, north of the discovery, has swabbed up to 114 bbl. of oil in 8 hours, cut with 12 per cent water.

Southeast of Andrews, Forest Oil Co. 1-C University had plugged back to 10,870 ft. to try for completion in the Pennsylvanian. Total depth was 14,027 ft., in the Ellenburger topped at 13,946 ft. by samples. Preliminary tests on perforations at 10,782-10,792 ft. gaged 93 bbl. of oil and 110 bbl. of water in 12 hours through ¼-in. choke. According to field sources, this section is below the Strawn, which flowed an estimated 100 bbl. an hour from the interval at 10,618-10,659 ft.

Ralph Lowe 1 Deep Rock, west of Andrews in the South Shafter Lake area, was showing for an Ellenburger discovery. On drill-stem test from 12,230-12,274 ft. fluid reached the top in 2 hours and 45 minutes, then flowed 56 bbl. of oil in 3 hours. Fluid in the pipe was reversed out, with no water evident. Top of the Ellenburger was 12,230 ft. on ground elevation of 3,195 ft.

Central Andrews County gained another Ellenburger test by Continental Oil Co. on the south side of Wemac field. Location was made for Continental 7 McCollum & Weibusch, which will be a ⅜-mile southeast offset to Continental's discovery in the field. Projected depth is 14,000 ft.

Hunt Oil Co. 1 White, 11 miles northwest of Andrews, and west of San Andres production in Means pool, was drilling below 13,115 ft. in lime and dolomite. Lowest marker reported was the Montoya at 12,590 ft.

Ector County . . . Phillips Petroleum Co. Ratliff, new pay discovery in Mac Boring-Wolfcamp field, flowed 30 bbl. of oil and 30 bbl. of mud in 1½ hours from perforations between 10,620-10,696 ft. A later test gaged 100 bbl. of new oil in 10 hours through ¼-in. choke. Pay section has been identified as the Pennsylvanian Bend, and field sources credit it as the first from that zone for the county.

Upton County . . . Gulf Oil Corp. 1-AE TXL has found oil-bearing section below the interval at 12,365-12,403 ft. which developed sulfur water on drill-stem test. A test of the lower zone, from 12,403-12,425 ft., recovered 290 ft. of oil and gas-cut mud and 340 ft. of clean 47° oil, with no water.

Humble Oil & Refining C. 1-B Corbett, southern Upton County, developed a heavy flow of oil from the Wolfcamp. Oil flowed in 6 minutes on test from 6,363-86 ft. and gaged 318.75 bbl. of 44° oil with no water in 6½ hours. Nearby production is from the Grayburg section.

Gaines County . . . This county gained another Devonian wildcat at Felmont Oil Co. 1 Terrell County School Land, northwest of Glasco pool and a northeast stepout to Rowan Drilling Co. 1 Brunson-Stanton. Other companies interested in this operation are Signal Oil & Gas Co., Stanolind Oil & Gas Co. and Rowan. Rowan 1 Brunson-Stanton developed oil and gas-cut mud on drill-stem test of the Mississippian from 11,475-11,565 ft. Drilling continued below 11,616 ft.

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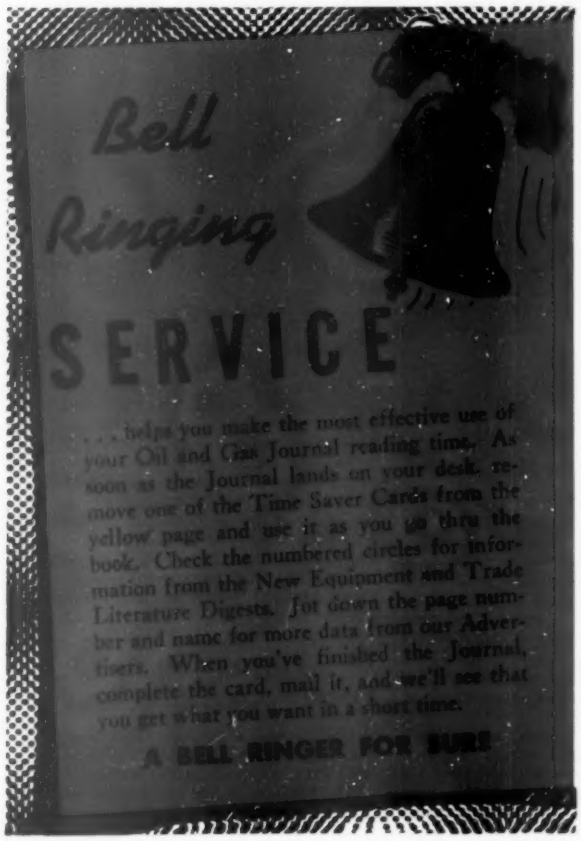
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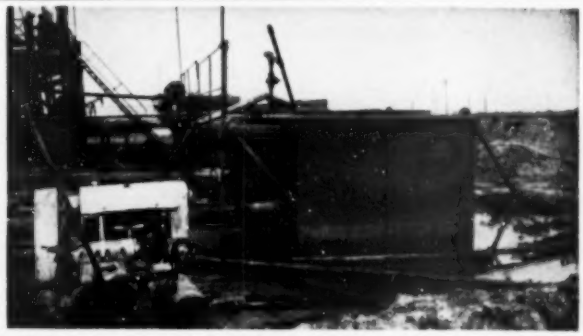

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Seminole, was drilling below 12,653 ft. in lime and chert.

Alsabrook 2 Riley, confirmation test to the Wolfcamp and Devonian discovery, was drilling below 5,453 ft. on 11,300-ft. contract. Location is a northeast offset.

ROCKY MOUNTAIN

WYOMING

Kirby Draw Wildcat Finds Frontier Gas

Sinclair Oil & Gas Co. recovered gas at the rate of 1,350,000 cu. ft. per day on test of the interval 4,500-25 ft. at 1 Unit, SW SW SE 27-33n-95w, in the Kirby Draw area, Fremont County. Test was in Frontier sand. The well is a scheduled 8,000-ft. test of Tensleep and is just east of the company's North Sand Draw discovery which was completed last year.

Weston County Discovery Flows Completed

Trigood Oil Co. of Casper has completed 1-A Government-Murray, C SW NE 27-41n-66w, in the South Cheyenne River area of Weston County after a flow of 129 bbl. of oil in 3 hours from the Newcastle sand zone 7,336-48 ft. The well is 1½ miles south of previous production in the trend south of Clareton, and about 2 miles north of the recent discovery by Cosden Petroleum Co. and others in northern Niobrara County.

Two Niobrara County Discoveries Indicated

Northern Drilling Co. reported a flow of 112 bbl. of oil in 12 hours following sandfrac at 1 Government-Sumpe, C SE SE 2-40n-66w, northwestern Niobrara County. A second treatment increased the flow to 15 bbl. per hour. The operator is continuing to test.

At another wildcat in the same township, H. & H. Drilling & Oil Co. reported a flow of 4 bbl. of oil per hour also after a second sandfrac at 1 Government, C NW NW 14-40n-66w. Both wells are in the area of heavy activity recently created in the northwestern portion of this county following the extension of Newcastle sand production into the county from the active South Clareton area of Weston County.

Mush Creek Well Flows

Dillard and Shenton of Newcastle reported a flow of 15 bbl. of oil per hour following sandfrac of Newcastle sand at 1 Government, NE NE SW 3-43n-63w, Mush Creek area, Weston County. The well is 1 mile south of production in the field, and is ½ mile south of a failure previously drilled on the south flank of the field. The well is reported shut in and to be completed later, and tops have not been reported. It is the first successful test in the area south of Mush Creek field.

MONTANA

New Shows Reported at North Bloomfield Wildcat

Stanolind Oil & Gas Co. recovered small amounts of free oil in two drill-stem tests of Silurian at 1-E NPRR, C NE SE 21-20n-52e, in the North Bloomfield area of Dawson County. Test of the interval 10,354-10,439 ft. recovered 25 ft. of 43.5°-gravity oil, 2,140 ft. of oil and gas-cut water cushion and 180 ft. of foamy oil and gas-cut mud. Flowing pressure was 915-1,035 psi. and tool was open for 3 hours. Another test 10,420-91 ft. recovered 60 ft. of oil, 2,040 ft. of oil and gas-cut water cushion and 2,360 ft. of oil and gas-cut salt water. The operator is coring below 10,541 ft.

NORTH DAKOTA

Hunt Stakes Stark County Wildcat

Hunt Oil Co. has made location for 1 Kudrna, C SW NW 20-139n-97w, a wildcat in Stark County. The well will test through Madison to about 10,000 ft. It is located on land farmed out from Deep Rock Oil Co. and contribution of acreage has been made by Northern Pacific Railroad Co. The well is about 6 miles southwest of the town of Dickinson, in an area where heavy geophysical work has been conducted during the past 2 years.

UTAH

Bluff Unit Wildcat Flows Oil

Three States Natural Gas Co. reported a flow of 85 bbl. of 53°-gravity oil in 6 hours from Hermosa at 1 Utah State, C SE SW 32-39s-23e, San Juan County. The well is on the 12,000-acre Bluff Unit in the southeastern part of the county, and is being drilled under arrangement with Shell Oil Co. Shell drilled a failure to 8,762 ft. about 1 mile north of 1 Utah State in 1951 which had substantial shows of oil.

The present well which reported shows some time ago was drilled to 7,762 ft., and was perforated in Leadville (Mississippian) with recovery of 6,000 M.c.f. of carbon dioxide gas per day with 5 bbl. of oil. After swabbing, the natural flow was 40 bbl. of oil and 1,000 M.c.f. of inflammable gas per day. The well was acidized prior to the 6-hour gage of 85 bbl. of oil. Gas was produced on this test at the rate of about 1,500 M.c.f. per day.

The operator is continuing tests at the wildcat which is the first to show apparently commercial results in the Paradox basin area of southeastern Utah. Shell is a major leaseholder through the area, and is reported planning a considerable program of exploration for the near future.

NEBRASKA

Permian Test Scheduled For Cheyenne County

Ohio Oil Co. will test to Permian, possibly deeper at WSGP 22 Chambers 1, SE SW SW 14-13n-51w, Cheyenne County, Nebraska. The well is in the general Southwest Sydney gas area. It became an apparent D sand oil discovery last week with recovery of 1,500 ft. of oil and 50 ft. of fresh water in 1-hour test of the zone 4,875-91 ft. Another test 4,891-99 ft. recovered 1,800 ft. of oil and 300 ft. of slightly brackish water also in 1 hour. It is 2 miles east of Cretaceous production in Shorts field.

Importance of the decision to continue drilling to deeper horizons lies in the fact that this part of Nebraska has had very little drilling below Cretaceous. Tests were drilled in Huntsman and North Sunol fields to the north without success. Following discovery of oil in the Lyons member of Permian at Keota and Black Hollow in Colorado, deep tests were drilled in Enders and Southwest Potter fields, Kimball County, considerably west of the Ohio wildcat. Neither of these was successful. However, a good development of Lyons sand was found at Enders, although it was water-bearing. The former deep tests at Huntsman and North Sunol reported no Lyons.

COLORADO

Southwestern Colorado Exploration Begun

Three States Natural Gas Co. has made location for a test of the Dove Creek area, Montezuma County, Colorado. The well is 2 White, C SE SE 33-39n-19w. Although gas was discovered in this area in 1948, the test by Three States is the first recent activity. Several wells were drilled following the discovery, but all were suspended indefinitely after testing varying shows. Production in the field is from Paradox. Gage on the discovery well was reported as 20 bbl. of oil per hour with 5,000 M.c.f. of gas per day through ¼-in. choke. Three States recently announced participation in a proposed pipe line from this area to the Denver area.

ARIZONA

Apache County Wildcat Has Additional Shows

Shell Oil Co. reported recovery of additional shows of oil and gas on further testing of its 1 Navajo, C SE SE 6-41n-29e, Apache County. The well made gas at the rate of 100,000 cu. ft. per day on test of the zone 4,886-4,978 ft. Pipe recovery was 530 ft. of slightly gas and oil-cut mud. Tool was open 2½ hours and flowing pressure was 150-400 psi. The operator is drilling below 5,207 ft.

The well attracted considerable attention with similar shows high in Hermosa about a week ago. It is southeast of production in Boundary Butte field in southeastern Utah.

LOUISIANA

NORTH LOUISIANA

Hico-Knowles Extended Westward More Than Mile

Atlantic Refining Co. has extended McFearin sand production about 1 mile to the west at 1 Wynn, SEc 19-20n-4w, Hico-Knowles field in Lincoln Parish.

The well was gaged at the rate of 165 bbl. of 53.6°-gravity condensate and 1,400 M.c.f. of gas per day on 7-hour test through ¼-in. choke from perforations at 9,084-9,102 ft. McFearin sand production is being developed on a 640-acre unit pattern, consisting of a quarter of four government sections along south flank of shallower Cotton Valley production in the field.

New Pay at Esperance Point in Concordia

Jett Drilling Co., Inc. has a new pay in the Wilcox at 1 Campbell in 7-5n-9e, Esperance Point field, Concordia Parish.

The new pay is the Barksdale sand. Campbell sand is the regular pay in the field. It had salt water in this well. The discovery

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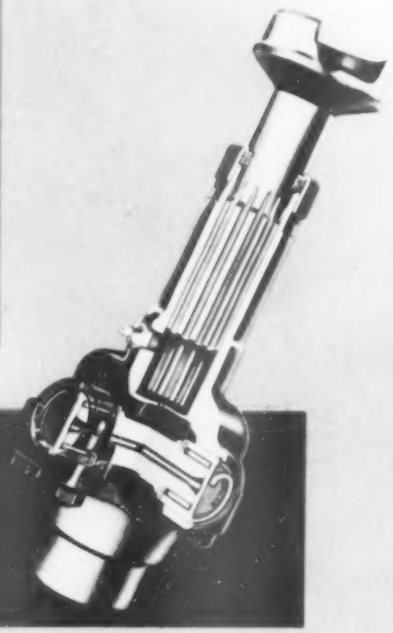

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flowed 105 bbl. of 46.5°-gravity oil daily through 7/64-in. choke.

January Has One Discovery, Two New Pays in Area

Jett Drilling Co., Inc. was the discoverer of the first new field in north Louisiana this year at 1 Learned, opening Black Hawk field in Concordia Parish.

The Wilcox Barksdale sand strike was finaled flowing 138 bbl. of 46.5°-gravity oil per day plus some gas through perforations at 8,008½-10½ ft.

Longwood field in Caddo Parish's new pay is the Nacatoch, opened by Joe M. Burnham at 2 Gardner in 17-19n-16w. The well flowed 325 M.c.f. of gas daily through ¼-in. choke from open hole at 860-867 ft. Longwood's other pays are the Fredericksburg, Pettit, Travis Peak, and Cotton Valley.

Upper Glen Rose production was established in Sibley field, Webster Parish, at Atlantic Refining Co. 1 Roberts in 34-18n-9w. The well flowed 103 bbl. of oil daily through ⅛-in. choke on 14-hour test from perforations at 4,780-87 ft. The field's other pays are the Rodessa, James, and Travis Peak.

APPALACHIAN AREA

WEST VIRGINIA

Clay district, Wirt County, West Virginia, United Fuel Gas Co. 6812 Cora L. Brown, deep wildcat test, elevation 1,063 ft., resulted in a dry hole and is being plugged, Cornif-erous lime 4,858 ft., Oriskany sand 5,030-5,164 ft., show of gas 5,125 ft., Clinton sand 4,045 ft., TD 8,206 ft. Middle Fork district, Randolph County, Nollem Oil & Gas Co. 1 Moore Kepple Co., elevation 2,276 ft., gaged 632,000 cu. ft. gas, Fifth sand 1,704 ft., gas 1,711 ft., TD 1,713 ft.

OHIO

Frank Brendel continues to have success along the south edge of Perryton-Frazeysburg pool in Jackson Township, Muskingum County. 2 J. W. Wright, Section 6, made a good showing in Clinton, found at 3,109-3,156 ft., and 200 bbl. in 24 hours after fracturing.

In Hanover field, the Wray Drilling 2 Frank Westbrook, Lot 10, Hanover Township, Licking County, logged the Clinton at 2,917-2,963 ft., and made 60 bbl. in 24 hours after fracturing.

Wm. Hoey et al 1 Edwin Brown, Section 1, Falls Township, Hocking County, reported Clinton sand at 2,647-2,680 ft. with 2 bbl. natural and 70 bbl. in 24 hours after fracturing. This is the third well, all small producers, to be drilled north of the city of Logan.

MISSISSIPPI

New Tuscaloosa Oil Field Opened in Lincoln County

A. O. Phillips 1 Rollins, new lower Tuscaloosa discovery-well in southeastern Lincoln County, flowed 340 bbl. of 38°-gravity oil in 24 hours through 10/64-in. choke on its potential gage. The discovery has been designated as Sweetwater field.

Pay zone, 127 ft. below the top of the lower Tuscaloosa section, is open through casing perforations at 10,783-97 ft.

The discovery, 15 miles southeast of Brookhaven, is the first in the deeper portion of the Mississippi embayment in several years. It is 8 miles south of Mallalieu field, nearest production.

Franklin Discovery Well Makes Pumping Producer

Completion of a new Wilcox discovery-well has been reported in southwestern Franklin County. It is J. Paul Ratliff and Petersen Drilling Co. 1 Butler, in 40-5n-1e, ½ mile east of Knoxville, and about 1½ miles northwest of North Freewoods field.

The well would not flow naturally, but, placed on the pump, produced 138 bbl. of 39°-gravity oil per day. Pay interval is 6,530½-33½ ft. in sidetracked hole, drilled

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to 6,605 ft. The discovery has been named for the Knoxville community.

ARKANSAS

Blossom Pay Established At Falcon In January

The first Blossom sand oil well in Nevada County's Falcon field was completed in January at Atkins & Pannell D-1 Russell, 50 ft. S of C NW NW SW 8-15s-22w. The well pumped 40 bbl. of 19°-gravity oil per day, 50 per cent water.

The well has since improved and is making full state allowable. Another Blossom well nearby is completing, both twin-well locations to Tokio producers.

CANADA

Light-Gravity Oil Found In West-Central Alberta

Shell Oil Co. has discovered light-gravity crude oil in the Cardium sand at its Shell-Peers 2 stratigraphic test venture in the central west sector of Alberta, 85 miles west of Edmonton and around 31 miles northwest of Pembina area Cardium oil production. This exploratory driller, in addition to finding the 34°-gravity oil in the Cardium, also gave up an encouraging showing of light-gravity crude in the Viking sand.

The 2 Peers LSD 11, 16-53-12w5, is 11½ miles west of Select Oils 1 Chip Lake wet gas discovery well and 28 miles east of the town of Edson. The Cardium sand test was run from 4,950-5,003 ft. for 60 minutes, and gave a good initial blow, with gas flowing at approximately 20,000 cu. ft. daily and pipe recovery being 500 ft. of clean oil. One-hour test in the Viking, 5,935-73 ft., weak initial blow, increasing and then decreasing in 15 minutes, recovered about 50 ft. of light-gravity oil and 170 ft. of oil-cut mud. The well is now deepening below 5,973 ft.

Pembina-Buck Creek . . . A new pool discovery or a 6½ mile extension has been chalked up in the southeast sector of the Pembina-Buck Creek region by a team of 10 companies and a group of individuals. The new producer, that has now further opened up the Cardium sand oil producing prospects, lies mid-way between the 12½ mile stretch that separates the previous Pembina Cardium oil producers from the Minnehik Viking oil discovery well.

The new strike came at Seaboard-Great Plains-Baysel 6-15 Buck Creek exploratory venture, which is on LSD 6, 15-47-7w5, 6½ miles southeast of the Socony-Seaboard 12-12 Pembina Cardium sand oil extension and 6 miles northwest of the Canadian Delhi-Great Plains et al 11-33 Minnehik venture that discovered oil in the Viking, wet gas in the Basal Cretaceous and was recorded as a wet gas extension in the Mississippian formation. The Cardium was entered at 5,168 ft. (2,178 ft. subsea), and 48-minute drill-stem test from 5,158-93 ft. flowed gas in 5 minutes at rate 200,000 cu. ft. daily and oil in 39 minutes. Recovery was 1,342 ft. of clean oil.

Most recent test, at bottom 55 ft. below the Cardium contact, from 5,192-5,223 ft., flowed gas in 34 minutes, at rate too weak to measure, and gave recovery of 110 ft. clean oil and 25 ft. of mud. Drilling is continuing.

Greenglade . . . Heavy gravity crude oil has been discovered by Shell Oil Co. in a basal sand of the Lower Cretaceous at its exploratory driller in the Greenglade area of central east Alberta, 38 miles southeast of Wainwright and 4 miles west of the Saskatchewan border. Three drill-stem tests were reported in the Cretaceous sand, two giving up 18°-gravity crude oil and the third yielding oil-cut mud and salt water.

This strike came at Shell A-8-17 Greenglade LSD 8, 17-41-1w4, 10 miles southeast of Chauvin (South) Colony sand heavy gravity oil production. First drill-stem test was run from 2,675 to 2,725 ft. for 1 hour. There was a faint blow throughout and recovery consisted of 30 ft. of oil and 50 ft. of oil-cut mud. One-hour test from 2,712-30 ft. gave a faint blow throughout, with recovery being 80 ft. of oil and 40 ft. of oil-cut mud. Test from 2,705-46 ft. yielded only 50 ft. of oil-cut mud and 1,550 ft. of muddy salt water in 1 hour. Drilling is now proceeding below 2,875 ft.

Pouce Coupe . . . A three company team of Canadian independents have struck a natural gas flow in the Cadotte sand at a wildcat in the Pouce Coupe area of far northwest Alberta, 60 miles northwest of Grande Prairie and 20 miles northeast of Dawson Creek, B. C.

This well is being drilled by Pathfinder Petroleums, Ltd., Gas Exploration Co. of Alberta, Ltd., and Canadian Admiral Oils, Ltd., on a 37,000-acre crown reservation farmout from Legion Oils, Ltd.

The new gasser is Pathfinder-Legion-Gas Ex.-Admiral 1 Bay Tree, LSD 6, 33-79-12w6, 10 miles north of the South Pouce Coupe gas discovery well. The Cadotte was contacted at 2,380 ft., or 187 ft. below sea level, and initial 1-hour drill-stem test was from 2,375-93 ft. Gas flowed in 3 minutes, at rate 1,820,000 cu. ft. daily through ½-in. choke. Pipe

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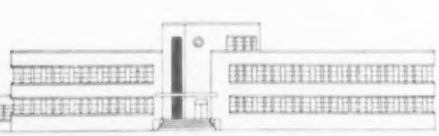

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recovery was 120 ft. of gas-cut mud. Coring and testing is being continued, with current depth at 2,405 ft.

EASTERN CANADA

On the Bald Mountain anticline, blanketed with a 54,000-acre concession, geological investigations have indicated a coral reef formation in limestones of Middle Silurian age. A heavy duty outfit, installed at the beginning of 1953, has deepened the hole to 6,170 ft. but heavy snow in December forced a shut down for the winter.

The Power-Joncas dome, in a remote section of the Gaspe Peninsula, has been favorably geologized, and here Quebec Oil 2 has been drilled to 6,000 ft. with good indications of softness and porosity from 4,750 ft. to bottom. Test is shut down pending change to a heavier rig.

The Tar Point anticline, a well defined structure where asphaltic crude seepages were noted nearly a century ago has been tested by the 1 Tar Point to 7,070 ft. depth. At 4,118 ft. a show of high gravity paraffin base crude was encountered, believed to have filtered upward from a lower formation.

At 7,070 ft. gas was encountered sufficient to lift tools, and since then the well has flowed steadily, and shut-in pressure tests are to be carried out.

Associated Developments, Ltd., is planning to start geological work and possibly drilling this year.

Ontario . . . In Elgin County, drilling operations are continuing in Aldborough Township 2 miles north of Rodney. Drilling was started early in 1953, and companies now active are Abbott Gas & Oil Co., Toronto; Elmer Roth Co., Hillsdale, Mich. Dominion Natural Gas Co., Buffalo; Alec Comfort Co.; Crown Oil Co.; Richfield Oil Co. Aldborough Gas & Oil Co.; and Westwood & Palenkos. Eight companies are actively drilling, and out of 91 wells in 1953, 84 were producers, some making up to 60 to 70 bbl. flush production, with average daily production per well estimated at 20 bbl.

The field is approximately 3½ miles long and 1¾ miles wide.

WILDCAT COMPLETIONS

SOUTHWEST TEXAS

Atascosa County: Carter & Carter 1 Prassel, W. W. Robins Sur. IP 105.23 BOPD, 12/64-in., 39°, Navarro 4,695-4,730 ft. (open hole). TD 4,730 ft. (New field.)

Caldwell County: Union Oil Co. of California 1 Hollamon, Hannah Leiper Sur., A-242. Dry. TD 9,202 ft.

Duval County: Corpus Christi Refining Co. 1 Sutherland, AB&M Sur. 179, A-26. Dry. TD 3,386 ft.

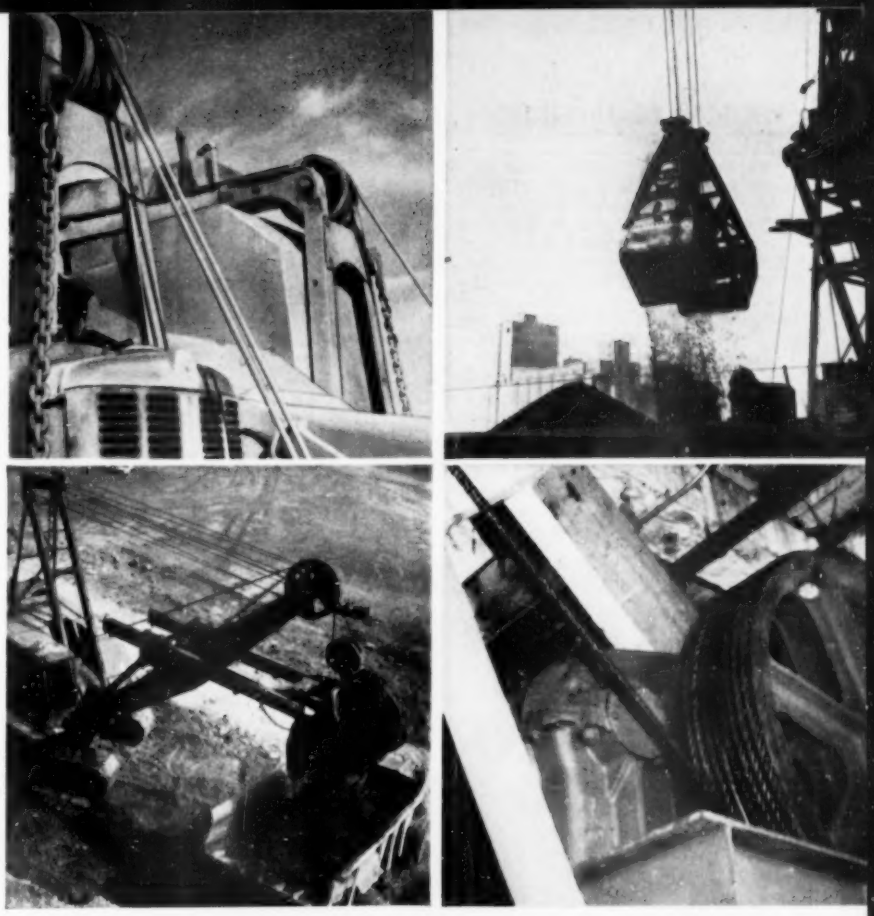
Frio County: Etheredge et al 1 Ferguson, Sec. 1, BS&F Sur., A-92. Dry. TD 2,974 ft.

Gonzales County: Rodney DeLange and O. Neathery, Jr., 1 Walters, Mary Ann Williams Sur., A-82. Dry. TD 6,009 ft.

Guadalupe County: Producers Corp. of Nevada et al 1 Darilek, John L. King Sur., A-26. Dry. TD 2,213 ft.

Hidalgo County: Hydrocarbon Production Co. 14 Crain & Griffith, Blk. 47, North Capisello Subd. IP 10,000 M.c.f. daily, open flow, perforations 7,503-11 ft. TD 8,021 ft. (New pay in Lacy field.)

Jim Wells County: Delta Gulf Drilling Co. 1 Kalinec, Share 4, La Vaca Grant, A-166. IP 13,500 M.c.f. daily with 20 BC per M.M.c.f., open flow potential, perforations 7,705-25 ft. TD 8,408 ft. (New field.)



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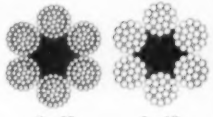

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WILDCAT COMPLETIONS

Republic Natural Gas Co. 1 Alegria, Lot 6, Ben Bolt Farm Tract, A-477. Dry. TD 6,006 ft.

Smith & Story 1 Lankford, H&GN Sur. 5, A-228. Dry. TD 3,105 ft.

Kleberg County: Humble Oil & Refining Co. 1 State Tract 7, Baffin Bay. Dry. TD 7,514 ft.

LaSalle County: H & J Drilling Co. 1 Schoolfield et al, BS&F Sur. 65, Certificate 1594, A-107. Dry. TD 2,050 ft.

McMullen County: J. R. Butler 4 Hays Ezzell, Blk. 1, Hays-Ezzell Subd., P. Fadden Sur., A-4. IP 39,000 M.c.f. daily, open-flow potential, perforations 1,195-99 ft. TD 1,559 ft. (New field.)

J. R. Butler 5 Hays-Ezzell, Blk. 14, Hays-Ezzell Subd., P. Fadden Sur., A-4. IP 26,200 M.c.f. daily, open-flow potential, perforations 1,201-11 ft. TD 1,576 ft. (Extends unnamed new field—see J. R. Butler 4 Hays-Ezzell.)

Medina County: R. S. Hays and Charles A. Daubert 1-A Carter, T. R. Littleton Sur. 152. Dry. TD 1,456 ft.

Nueces County: H. J. Hunt 1 Eggert, Sec. 2, George H. Paul Subd. of Driscoll Ranch. Dry. TD 7,217 ft.

Selby-Walker Corp. 1 Joslin, Lot 8, Sec. 28, Flour Bluff and Encinal Farm and Garden Tracts. IP 22,500 M.c.f. daily, open-flow potential, perforations 6,631½-39½ ft. TD 6,643 ft. (Extends East Flour Bluff field.)

San Patricio County: Jake L. Hamon 1 Meehan, Lot 18 Toribio Molina Sur., A-18. IP 18.63 BOPD, 7/64-in., 47.6°, perforations 5,330-35 ft. TD 6,514 ft. (New field.)

Woodson Oil Co. 1 Schmidt, Tract 7, Schleicher and Joseph Subd. Dry. TD 4,902 ft.

Starr County: Sotex Oil & Gas Corp. 1 Starr County Cattle Co., Blk. 25, Jefferies & Lambert Subd., Porcion 89 (Barbacosa area). Dry. TD 4,020 ft.

Travis County: M. J. Simmons 1 Schiller, Pedro Rodriguez Sur. Dry. TD 1,250 ft.

Webb County: Skelly Oil Co. 1 Martin, LIM&C Sur. 473, A-1539. IP 8,100 M.c.f. daily, open-flow potential, perforations 6,255-76 ft. TD 8,504 ft. (New field—Aguilares.)

TEXAS GULF COAST

Bee County: Stanolind Oil & Gas Co. 1 Garner, B. D. Custer Sur., A-554. IP 22,000 M.c.f. daily, open flow, perforations 8,336-42 ft. and 8,346-51 ft. TD 8,772 ft. (New pay and extends unnamed gas-condensate discovery).

Brazoria County: Phillips Petroleum Co. 1 Anderson & Petersen, Lot 21, Block A, S. F. Austin 1¾ Lge., A-37. IP 171.59 BOPD, ⅛-in., 37.6°, perforations 11,334-40 ft. TD 11,739 ft. (New field).

Texas Eastern Production Co. 1 North Rowan Unit 2, Lot 18, Francis Moore Sur., A-100. IP 61.52 BOPD, ⅛-in., 43.5°, perforations 9,572-78 ft. TD 11,071 ft. (New pay in, and extends North Rowan field).

Colorado County: Skelly Oil Co. 1 Labay, Sam Kennelly Sur., A-30. IP 800,000 M.c.f. daily, open flow, perforations 6,525-30 ft. TD 9,237 ft. (Extends Englehart field).

Galveston County: Humble Oil & Refining Co. 1 Coon fee et al, A. Burke Sur. 3, A-26. Dry. TD 12,300 ft.

Goliad County: Horace Coon, Jr., 1 Wilhelm, Joseph T. Kilgore Sur., A-172. Dry. TD 4,113 ft.

Harris County: R. W. Ramey 6 Jones et al, J. Donnelly Sur. IP 124.76 BOPD, 8/64-in., 38.4°, perforations 5,765-67 ft. TD 7,010 ft. (New pay in Huffsmith field).

Jackson County: John F. Merrick 1 Kolle, Pedro Gallardo Sur., A-23. Dry. TD 5,035 ft.

Union Sulphur & Oil Corp. 2-A L. Ranch, John Brown Sur., A-10. Dry. TD 9,520 ft.

Karnes County: Armstrong & Horn 1 Wright, F. Anthony Sur., A-18. Dry. TD 1,539 ft.

Liberty County: Texas State Drilling Co. 1 LaCour, Joseph Dunman Sur., A-32. Dry. TD 8,297 ft.

Madison County: The Texas Co. 1-B Forrest, F. Fulsher Sur., A-14. Dry. TD 10,150 ft.

Montgomery County: Moran Corp. and Gar-Flo Oil Co. 1 Hunt & Floyd, John Bricker Sur., A-71. IP 134.7 BOPD, ⅛-in., 36.2°, perforations 5,128-31 ft. TD 8,805 ft. (New field).

Victoria County: P. R. Rutherford et al 1-F Shelton et al, Placedo Benavides Sur., A-124. Dry. TD 8,024 ft.

Meredith & Co. 1 Knolle, Manuel Marquez Sur., A-84. Dry. TD 5,314 ft.

Walker County: Panuco Oil Leases, Inc., 1 Gibbs, George Weedon Sur. Dry. TD 5,552 ft.

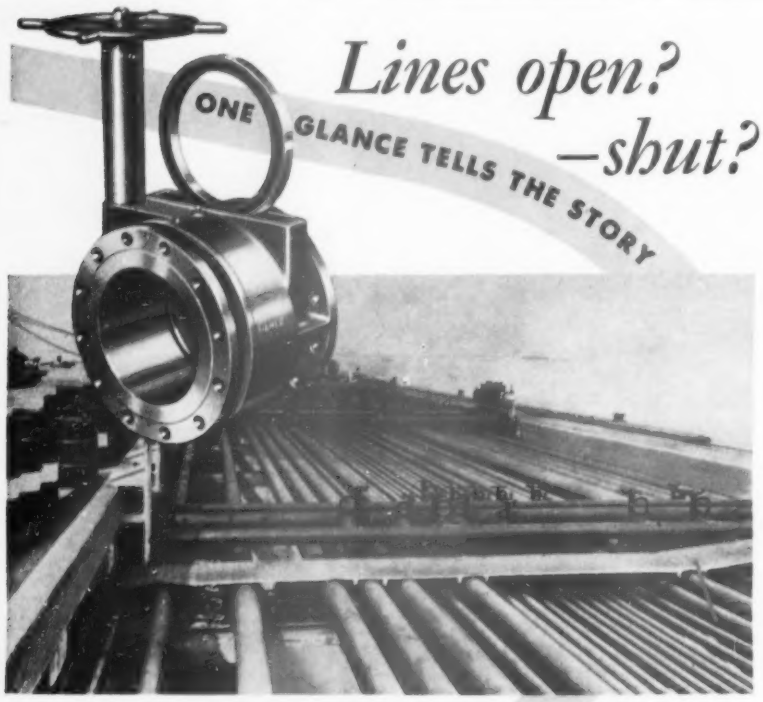
EAST TEXAS

Bosque County: O. C. Profitt 1 Henry, A. B. King. Sur. Dry. TD 4,000 ft.

Limestone County: Hamman Oil & Refining Co. 1 Gunter, H&TC Sur. Dry. TD 2,161 ft.

Navarro County: John W. Hoosier 1 Shelton, R. D. Newman Sur. Dry. TD 3,400 ft.

W. E. Stewart 1 Jackson, R. C. Dooms



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Rusk County: Norman V. Kinsey 1 Moore, James McCune Sur. Dry. TD 7,954 ft.

McAlester Fuel Co. 1-A Roquemore, Jacob Roth Sur., A-35, 1 mile N Pleasant Grove field. IP 222,000 cu. ft. gas, 12/64-in., Woodbine 3,911-14 ft. TD 4,045 ft.

TEXAS PANHANDLE

Childress County: Sterling Oil Co. of Oklahoma 1 Clark Ranch, 35-9-H&GN. Dry. TD 7,115 ft.

Dallam County: Panoma 1 Hill, Blk. 19, Sec. 10, CSS Sur. Dry. TD 6,037 ft.

Hartley County: Kerr-McGee 1 Shelton, Sec. 3, Bravo Subd., SCL Sur. Dry. TD 4,195 ft. Stratigraphic test.

Ochiltree County: Wm. H. Black and T. H. Barton 1 Batman, T. Edwards Sur. Dry. TD 7,510 ft.

WEST CENTRAL TEXAS

Brown County: Jackson & Frost 1 Windham, Sec. 51, E. Votaw Sur. 229. Dry. TD 1,206 ft.

Callahan County: Pethybridge & Erlich 1 Scott, Sec. 207, Mial Scurlock Sur. IP 60 BOPD, 16/64-in., 42°, Cross Plains sand 1,810-12 ft. TD 1,816 ft.

Texo Oil Co. 1 Hayden, Sec. 115, University Lands Sur. Dry. TD 2,523 ft.

Coleman County: Falcon Oil Corp. 1 Gilbreath, Subd. 18, L. G. Manson Sur. 80. Dry. TD 2,280 ft.

Pan-Tex Drilling Co. 1 Howell, A. G. Foley Sur. 683. Dry. TD 2,950 ft.

Eastland County: Standard Carbon Co. 1 Genoway, Sec. 13, SA&MG Sur. Dry. TD 3,047 ft.

Fisher County: Frank L. Lebus 1 Jameson, 93-1-H&TC. Dry. TD 5,300 ft. reef 5,098 ft.

Haskell County: Texas Crude Co. 1 Stremmel, 18-2-H&TC. Dry. TD 5,832 ft.

Jones County: C. S. and R. L. Beck and Gene Lawrence 1 Ekdahl, 18-3-H&TC. Dry. TD 2,172 ft.

The Chicago Corp. 1 Delk, 155-1-BBB&C. Dry. TD 3,450 ft.

Shackelford County: M. J. Mitchell 1 Carter, Sec. 70, BAL Sur. Dry. TD 4,305 ft. Elev. 1,397 ft., Lake sand 3,918 ft.

M. J. Mitchell 1 Pritchard, Sec. 44, BOA Sur. IP 240 BOPD, ¾-in., 41°, Sedwick 3,914-22 ft. TD 4,298 ft.

Taylor County: George M. Straughn 1 Brown, James Vaughn Sur. 54. Dry. TD 4,998 ft.

Throckmorton County: Allison Meller Supply Co. 1 Ham Unit, Sec. 986, TE&L Sur. Dry. TD 4,662 ft. Mississippian 4,618 ft.

C. P. Thurlkill 1 Houston, BBB&C Sur. 295. Dry. TD 1,250 ft.

NORTH TEXAS

Archer County: Bridwell Oil Co. and Moran Bros. 2-A Hammon, H. Corzine Sur., A-56. Dry. TD 3,665 ft.

Clay County: John R. Less 1 Callaway, Blk. 24, Hopkins CSL. Dry. TD 4,825 ft.

Warner C Northcutt 1 Cecil Thomas, Blk. 34, Freestone CSL, A-144. IPP 47 BOPD, Strawn 4,108-15 ft. TD 4,180 ft.

Cooke County: Kay Kimbell 1 Thurman, H. Edmiston Sur., A-354. IPP 21.5 BOPD, 34°, sand pay 3,146 ft. TD 3,152 ft.

Grayson County: Sinclair Oil & Gas Co. 1 Crockham, Juan Armendaris Sur., A-1400. Dry. TD 7,195 ft.

Jack County: Rankin, Pitcock & Karper 1 Kinder, James Knight Sur., A-2168. IP 3,500,000 cu. ft. gas. TD 4,700 ft.

Montague County: Jack Grace Production Co. 2 Boedecker, J. Diaz Sur., A-183. IP 142 BOPD, 32/64-in., 42°, conglomerate 5,862-74 ft TD 6,065 ft.

Young County: Hayden Farmer 3 Lee, Blk. 207, TE&L Sur., A-454. IPP 16 BOPD, 39°, pay 758 ft. TD 759 ft.

Helm & Orr 1 Perkins, TE&L Sur. 7, A-876. Dry. TD 637 ft.

Jim-Lee Drilling Co. 1 Hughes, TE&L Sur. 1108. Dry. TD 4,607 ft.

Homer G. Maxey 1 Corbett, TE&L Sur. 1113. IP 127 BOPD, 11/64-in., 45°, pay 3,367 ft. TD 3,383 ft.

Louis Pitcock 1 Bloodworth, W. Southerlin Sur., A-270. Dry. TD 3,526 ft.

Star Oil Co. 3 Hockaday Ranch, J. H. Haynes Sur., A-1870. IP 145 BOPD, ¼-in., 37°, pay 4,234 ft. TD 4,255 ft.

L. L. Wainwright 1 Preston Bruton, Sec. 2251, TE&L Sur. IPP 23 BOPD, 38°, pay 543 ft. TD 552 ft.

WILDCAT COMPLETIONS

WEST TEXAS

Andrews County: Continental Oil Co. 5 McCollum & Wiebusch, 24-A44-PSL, 6 miles SE Andrews. IP 660 BO in 12 hours, 20/64-in., pay 13,306-13,343 ft., 50°, Elev. estimated 3,111 ft., top Ellenburger 13,245 ft. TD 13,554 ft. New pay in Wemac field.

Borden County: Skelly Oil Co. 1 Windham, 674-97-H&TC. Dry. TD 8,561 ft. Ellenburger 8,550 ft.

Stephens Petroleum Co. 1 Bacon, 49-25-H&TC. Dry. TD 7,206 ft. Elev. 2,370 ft., Canyon 7,148 ft.

The Texas Co. 8-A Clayton, 32-32-T4N-T&P. IP 515 BOPD, ½-in., 45°, reef pay 8,099-8,114 ft. TD 8,127 ft. Extension well.

Coke County: Dudley Daugherty 1 Whiteside estate, 293-1A-H&TC. Dry. TD 6,615 ft. Elev. 2,288 ft., Ellenburger 6,464 ft.

United Production Co. 1 Nora Gee, 144-

the answer to many of your drilling problems

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WILDCAT COMPLETIONS

2-H&TC. Dry. TD 8,341 ft. Elev. 2,617 ft., Ellenburger 8,030 ft.

Crockett County: Humble Oil & Refining Co. 1 South Gilcrease Oil Unit 1, 48-31-H&TC. Dry. TD 7,902 ft. Elev. 2,266 ft., Simpson 6,900 ft., Ellenburger 7,775 ft.

John I. and P. D. Moore 1-P Shannon, 11-9-D&SE Sur. IP 7,400,000 cu. ft. gas, San Andres 1,732-36 ft. TD 1,866 ft.

Dawson County: Carlton Beal & Associates et al 1 Adkins, 20-35-T5N-T&P. Dry. TD 9,655 ft. Elev. 2,947 ft., reef 9,615 ft.

Ector County: The Texas Co. 65 Connell, NCT-2, 4-B16-PSL Sur. IPP 117 BOPD, 39°, pay 4,453 ft. TD 4,600 ft.

Gaines County: Cities Production Co. 1 Helen Peters, 208-G-WTRR Sur. Dry. TD 10,502 ft. Elev. 3,424 ft. Wolfcamp 10,080 ft.

Humble Oil & Refining Co. 2 James Riley, 363-G-CCSD&RGNG. IPP 109 BOPD, 35°, pay 7,148-7,221 ft. TD 9,005 ft. Clear Fork discovery in North Riley field.

Fred W. Shield 1 Richards, 60-H-D&W. Dry. TD 5,315 ft.

Glasscock County: Duncan Drilling Co. et al 1 Reynolds, 38-32-T4S-T&P. Dry. TD 2,742 ft.

Kent County: Blanco Oil Co. 1 Edwin George heirs, 197-G-H&TC. Dry. TD 6,750 ft.

Mitchell County: Lee Drilling Co. 1 Dixon, 2-1A-H&TC. IP 729 BOPD, ½-in., 41°, Strawn sand pay 6,200 ft. TD 6,347 ft.

Reagan County: T. J. Sivley 1 Young, 2-A826-C&MRR. Dry. TD 2,596 ft.

Runnels County: Frank Love & Co. 1 Barker, Underwood Sur. 733. Dry. TD 4,267 ft.

Terry County: Harper & Huffman 1 Givan, 32-D11-SK&K. Dry. TD 7,512 ft.

Tom Green County: Ryan & Burke 1 Johnson, 11-24-H&TC. Dry. TD 6,260 ft. Elev. 2,302 ft., Ellenburger 6,050 ft.

Ward County: Argo Oil Corp. 1 Wilson, 134-34-H&TC, 7 miles W Pyote. IP 24 BOPD, 13/64-in., 38°, Delaware sand 5,020 ft. TD 5,464 ft.

SOUTHEAST NEW MEXICO

Eddy County: Skelly Oil Co. 6-A Lynch-Federal, 22-17s-31e. IP 196 BOPD, 51°, GOR 21,080 cu. ft., Pennsylvanian pay 11,962 ft. TD 13,196 ft. Deep pay discovery in Fren area.

Lea County: Sinclair Oil & Gas Co. 1 Federal-331, 30-26s-38e. Dry. TD 3,800 ft.

Southern California Co. 1 Federal, 1-21s-32e. Dry. TD 3,508 ft.

Roosevelt County: Makin Drilling Co. & Miller 1 Seefeld, 29-5s-37e. Dry. TD 4,173 ft. Elev. 4,012 ft., San Andres 3,245 ft.

ILLINOIS

Bond County: The Texas Co. 1 Langel, SE NW SE 1-5n-4w. Dry. TD 2,325 ft.

Christian County: Collins Bros. 1 Gordon, NE SE SW 22-14n-1e. Dry. TD 2,410 ft.

Collins Bros. 1 Bays, SW SW SE 26-14n-1e. Dry. TD 3,070 ft.

Clinton County: L. Kapp 2 Gherardini, NW SE SE 17-1n-1w. Dry. TD 1,383 ft.

Edgar County: C. Watters 1 Stipp, SW SW NE 25-13n-11w. Dry. TD 1,235 ft.

Franklin County: Collins Bros. 1 Crowe, NW SE SE 1-7s-3e. Dry. TD 3,146 ft.

Jersey County: Carline Wilson 1 Beilsmith, NW SW NW 12-7n-10w. Dry. TD 1,410 ft.

Marion County: H. E. Robison 1 Hester, SW SE SE 22-2n-2e. Dry. TD 2,157 ft.

Welker Oil Co. 1 Henson, SW SW SW 2-1n-3e. Dry. TD 2,672 ft.

McDonough County: Faith Oil Co. 1 Bacon, SW SW NW 33-6n-2w. Dry. TD 1,084 ft.

Pulaski County: W. E. Vick 1 Boyd, NW NE SW 5-16s-1w. Dry. TD 1,366 ft.

S. Vance 1 Hudson, SE SW SE 23-16s-1w. Dry. TD 3,320 ft.

Shelby County: C. Lowery 1 Rogers, NW NE NW 24-10n-4e. Dry. TD 1,201 ft.

Wabash County: E. H. Morris 1 Brinkley-Dager, NW SW SE 31-2n-11w. Dry. TD 2,119 ft.

Warren County: B. D. Gunter 1 James Van Arsdale, NE SW NE 7-8n-3w. Dry. TD 545 ft.

Washington County: H. R. Pennington 1 Kuhn, NE NE NE 28-1n-1w. Dry. TD 1,559 ft.

Wayne County: Parker Bros. 1 Barr, SE SE NW 8-2s-6e. Dry. TD 3,346 ft.

INDIANA

Gibson County: Calvert Drilling Co. 2 Blood, NW SE NE 14-3s-13w. Dry. TD 2,380 ft.

Pike County: M. W. Brewer 1 Richardson, SE SE SE 19-1s-6w. Dry. TD 1,288 ft.

Spencer County: R. E. Hupp 1 Ferguson, NW NE NE 17-5s-5w. Dry. TD 1,241 ft.

Hupp & Hume Producers 1 Wetherill, N½ NE SW 4-6s-5w. Dry. TD 1,197 ft.

KENTUCKY

Daviess County: C. E. O'Neal 1 Rody, NE SW NW 1-O-27. Dry. TD 2,296 ft.

J. C. Ellis 2 F. M. Ashby, NE SE SE 14-P-30. Dry. TD 1,586 ft.

Henderson County: White & Vickery 1 Jones, SW SE NW 3-O-25. Dry. TD 802 ft.

Logan County: Morgan Petroleum Corp. 1 Roberts, SW SW SW 19-F-34. Dry. TD 1,410 ft.

McLean County: Coy Oil Co. 1 Kittinger, NW NW SW 18-N-27. Dry. TD 2,434 ft.

Coy Oil 1 Tomes, NE NE SE 20-N-26. Dry. TD 2,520 ft.

Muhlenberg County: W. E. Vict 1 Talbert, NW NW NW 1-G-30. Dry. TD 815 ft.

Union County: Ryan Oil Co. 1 Hunter Bros., NE NW SW 9-O-18. Dry. TD 3,035 ft.

MICHIGAN

Allegan County: P. K. Degenther 1 U. S. Government, SW NE SE 33-3n-14w. Dry. TD 1,444 ft. in Traverse lime.

Isabella County: John Neyer 1 Powell, N½ NE NE 30-16n-5w. Dry. TD 3,847 ft. in Dundee.

Washtenaw County: Ferguson & Ferguson 1 Gibson, SE SW NE 29-4s-4e. Dry. TD 1,232 ft. in Dundee.

WEST VIRGINIA

Randolph County, Middle Fork district: Nollem Oil & Gas Co. 1 Moore Kepple Co., elevation 2,276 ft., 632,000 cu. ft. gas, Fifth sand 1,704 ft., gas 1,711 ft., TD 1,713 ft.

Wirt County, Clay district: United Fuel Gas Co. 6812 Cora L. Brown, elevation 1,063 ft. Dry. Corniferous lime 4,858 ft., Oriskany sand 5,030-5,164 ft., show of gas 5,125 ft., Helderberg 5,164-5,585 ft., Tonolway 5,585-5,980 ft., Newburg 6,120-6,395 ft., Tonolway (second section) 6,395-6,870 ft., Newburg (second section) 7,148-7,160 ft., Keefer 7,545-7,584 ft., Clinton sand 8,045-8,206 ft., TD 8,206 ft.

MISSISSIPPI

Franklin County: Como Drilling Co. and Calton Oil Co. 1 C. A. Buckels est., 9-6n-3e. TD 6,513 ft., Elev. 276 ft., Wilcox 4,194 ft., base Baker shale 5,952 ft.

J. Paul Ratliff and Petersen Drilling Co. 1 Butler, 40-5n-1e. IPP 138 BOPD, 39°, Wilcox 6,531-35 ft. (perforations), TD 7,010 ft. Elev. 190 ft., Wilcox 4,575 ft., base Baker shale 6,329 ft., Walker zone 6,528 ft.

Lincoln County: A. O. Phillips 1 Rollins, C SE SE 23-5n-8e. IP 340 BOPD, 10/64-in., 38°, lower Tuscaloosa 10,785-91 ft. (perforations). TD 10,944 ft. Elev. 424 ft., Tuscaloosa 9,781 ft., lower Tuscaloosa 10,656 ft., lower Cretaceous 10,940 ft.

ALABAMA

Marion County: Harry L. Cullet 1 Ritch, 27-11s-14w. Dry. TD 4,678 ft. Elev. 465 ft., Iowa 1,830 ft., Devonian 2,050 ft., Silurian 2,200 ft., Ordovician 2,585 ft., Knox 2,985 ft.

SOUTH LOUISIANA

Acadia Parish: Stanolind Oil & Gas Co. 1-A Clement, 54-9s-2w. Dry. TD 12,792 ft.

Pan American Production Co. 1 Daigle, 78-8s-2e. IP 149 BCPD and 4,900 M.c.f. daily, 10/64-in., 48.2°, casing perforations 10,950-54 ft. TD 11,069 ft.

Beauregard Parish: Arthur O. Wellman & Sons and Ted Weimer 1 Lutcher-Moore, 23-3s-11w. Junked hole. TD 4,522 ft.

East Baton Rouge Parish: James N. Snowden et al and Westbury Petroleum Co. 1 Kleinpeter, 77-8s-1e. Dry. TD 10,905 ft.

Iberville Parish: Natural Gas & Oil Corp. 1 Wilbert, 72-8s-9e. Dry. TD 10,740 ft.

Lafourche Parish: California Co. 2 City of New Orleans, junked hole. TD 14,532 ft.

OKLAHOMA

Beckham County: Pure Oil Co. et al 1 Bohannon (Unit), SE SW NE 10-9n-23w. Dry. TD 11,327 ft.

Garfield County: Wolfe Drilling Co. 1 Simmons, NW NW SW 10-22n-4w. Dry. TD 5,786 ft.

Geo. Greer and San Juan Drilling Co. 1 Hammer, NE NW NE 2-20n-5w. IPF 209 BOPD, Misener sand 6,646-60 ft., 43°, 6/64-in., TD 6,951 ft. (Oil discovery.)

Garvin County: Sun Oil Co. 1 Caldwell, SW SE NE 4-4n-2e. IPF 242 BOPD, Burns 3,400-20 ft., 41°, 13/64-in., TD 4,697 ft. (Oil discovery.)

Vickers Exploration, Ltd., 1 Parr, C NE SE 20-2n-3w. Dry. TD 10,027 ft.

Kay County: Aylward Drilling Co. 1 Huster, NE NE SW 1-28n-3e. Dry. TD 3,140 ft.

L. C. Smitherman 1 Fender, SW SW SW 35-29n-1e. Dry. TD 3,713 ft.

Royal Oil Co. 1 Hunter, NW NW SE 26-29n-1w. Dry. TD 3,470 ft.

Lincoln County: Kingwood Oil Co. 1 Garrett, SE SW NE 14-15n-3e. Dry. TD 4,281 ft.

Berg & Buck Drilling Co. 1 Johnson, SE SE NE 11-15n-4e. Dry. TD 4,099 ft.

Love County: Gulf Oil Corp. 1 Riner, SW SW SW 32-5s-2e. IPF 10 BOPD, 2,590 M.c.f. of gas per day, 4,880-4,914 ft., 50°, 2-in. tubing choke. TD 7,310 ft. (Gas-distillate discovery.)

Okfuskee County: Rockhill Oil Co. et al 1 Westbrook, SE SW NE 28-11n-10e. Dry. TD 3,400 ft.

Osage County: Albert 1 Osage, SW SW NE 33-24n-6e. Dry. TD 2,910 ft.

Pawnee County: Falcon-Seaboard Drilling Co. 1 Hudson, NE NE NW 10-20n-5e. Dry. TD 3,829 ft.

Payne County: Ashland Oil & Refining Co. and Auto Transports, Inc. 1 Keirn, SE SE SW 18-20n-4e. Dry. TD 4,378 ft.

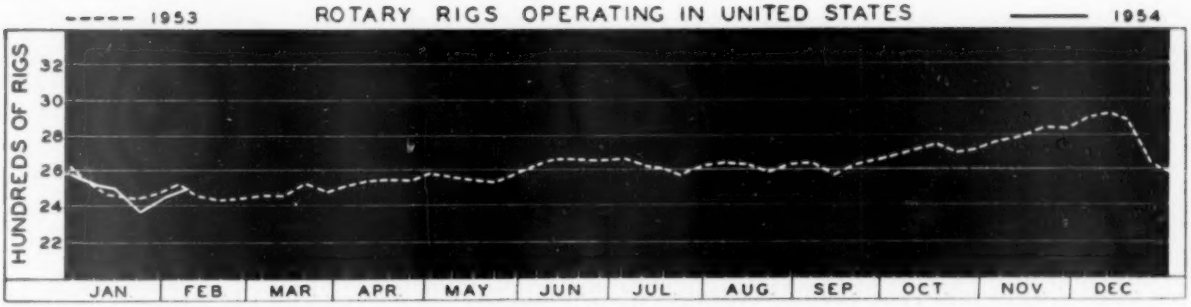
Pontotoc County: J. Carson 1 Chandler, NE NW SE 21-5-7e. Dry. TD 2,017 ft.

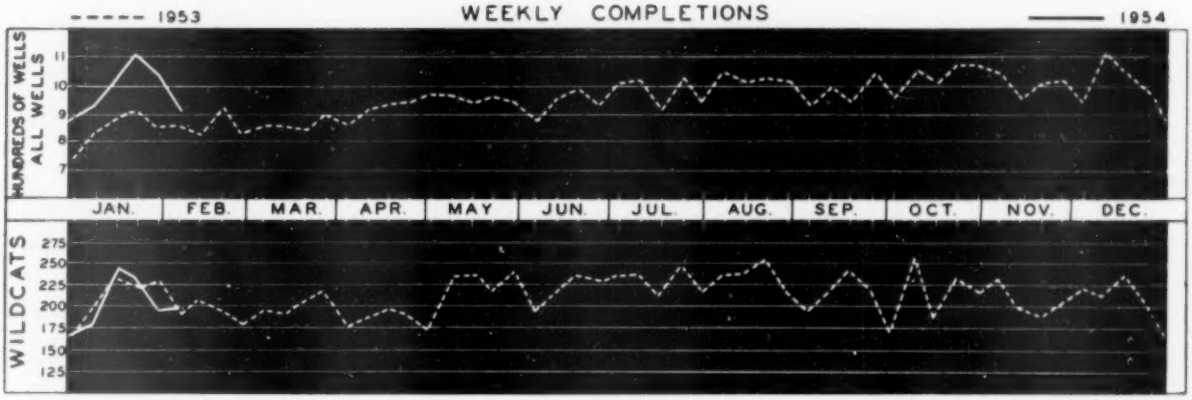
KANSAS

Cowley County: Boris Kramer 1 Gentry, NW NE NW 31-31s-4e. Dry. TD 3,005 ft.

Greenwood County: L. G. Broiles 1 Sanitor, SE NE NW 1-25s-11e. Dry. TD 1,849 ft.

(Continued on page 244)





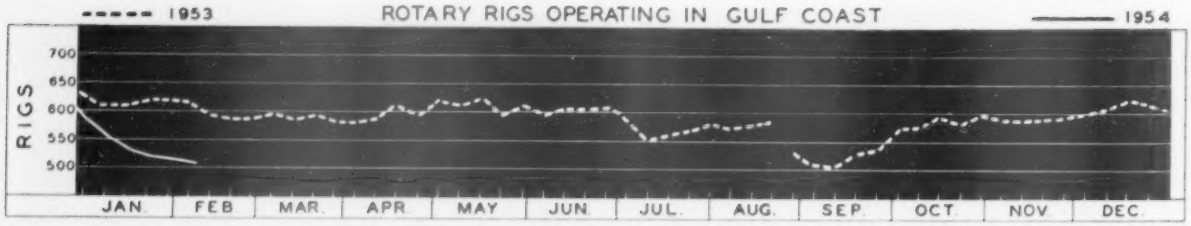
CURRENT STATISTICS

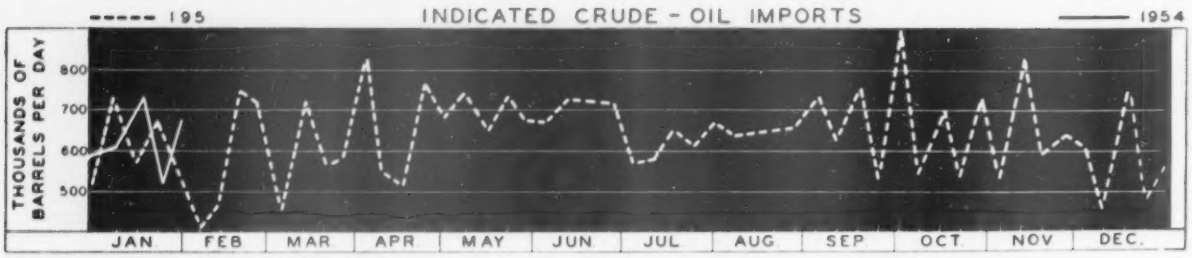
EXPLORATION

WEEKLY WELL COMPLETIONS . . . WEEK ENDED FEBRUARY 6, 1954

	Total of all wells					Feb. 6		Wildcat completions and discoveries					Cumulative total, 1954				
	Comp.	Oil	Gas	Dry	Footage	1954	1953	Oil	Dist.	Gas	Dry	Total	Oil	Dist.	Gas	Dry	Total
Pennsylvania-New York	46	22	4	*20	75,730	265	240	0	0	0	4	4	0	0	1	6	7
West Virginia	9	0	8	1	29,984	51	52	0	0	1	1	2	0	0	3	3	6
Ohio	20	8	2	10	35,913	94	94	0	0	0	0	0	0	0	2	1	3
Indiana	15	5	0	10	23,469	67	156	0	0	0	4	4	0	0	0	17	17
Kentucky	25	11	0	†14	33,654	107	115	0	0	0	8	8	0	0	0	15	15
Illinois	67	39	0	28	165,528	291	210	0	0	0	17	17	0	0	0	57	57
Michigan	8	5	0	3	26,161	69	69	0	0	0	3	3	0	0	0	31	31
Kansas	60	30	6	‡24	202,689	465	447	0	0	0	6	6	6	0	2	64	72
Nebraska	4	2	1	1	20,550	39	30	0	0	0	1	1	3	0	0	10	13
Oklahoma	140	95	2	§43	553,848	1,010	641	3	0	0	13	16	14	0	2	76	92
Texas	339	201	32	106	1,555,399	1,830	1,562	22	3	8	60	93	90	11	19	429	549
North Central (Dist. 7-B & 9)	115	78	1	36	370,938	638	514	9	0	1	19	29	53	0	1	155	209
West (Dist. 7-C & 8)	77	54	1	22	422,342	429	369	6	0	1	14	21	18	0	1	83	102
Panhandle (Dist. 10)	21	13	7	1	62,048	87	80	0	0	0	0	0	0	0	2	4	6
Eastern (Dist. 5 & 6)	21	6	5	10	106,569	80	70	1	0	1	4	6	2	0	2	20	24
Gulf Coast (Dist. 2 & 3)	50	23	9	18	339,757	312	243	4	0	2	10	16	8	5	6	82	101
Southwest (Dist. 1 & 4)	55	27	9	19	253,745	284	286	2	3	3	13	21	9	6	7	85	107
Louisiana	39	24	1	14	300,177	392	270	1	1	0	7	9	11	5	3	30	49
Northern	13	8	1	4	54,213	221	125	0	0	0	2	2	2	0	0	9	11
Southern	26	16	0	10	245,964	171	145	1	1	0	5	7	9	5	3	21	38
Arkansas	8	6	0	2	20,980	83	47	0	0	0	1	1	4	0	0	9	13
Mississippi	5	3	0	2	34,351	36	43	2	0	0	1	3	2	0	0	11	13
Southeastern States	1	0	0	1	4,678	12	14	0	0	0	1	1	0	0	0	10	10
Montana	8	4	0	4	33,289	30	37	0	0	0	3	3	0	0	0	10	10
Wyoming	32	21	2	9	162,543	172	54	1	0	1	4	6	7	0	1	25	33
Colorado	23	12	1	10	134,697	103	58	0	0	0	9	9	2	0	0	50	52
Utah	0	0	0	0	0	8	7	0	0	0	0	0	0	0	0	3	3
New Mexico	14	7	3	4	183,710	151	128	1	0	0	3	4	1	0	1	14	16
California	39	32	2	5	195,017	249	246	0	0	0	5	5	10	0	3	44	57
North Dakota	2	1	0	1	16,809	26	26	0	0	0	0	0	1	0	0	6	7
Miscellaneous (S. D.)	1	0	0	1	4,346	6	6	0	0	0	1	1	0	0	0	6	6
Total United States	905	528	64	313	3,813,522	5,556	4,552	30	4	10	152	196	151	16	37	927	1,131
Total previous week	1,045	606	64	375	4,244,812			37	2	2	151	192	121	12	27	775	935
Total Feb. 7, 1953	861	443	65	353	3,644,101			26	2	7	161	196	148	15	35	945	1,143

Service wells included: *17, †1, ‡4, §3.

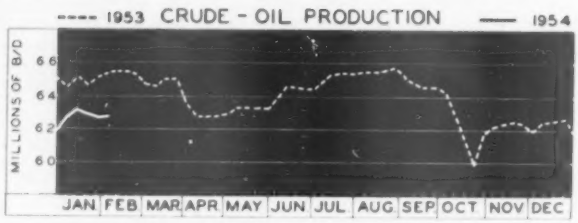


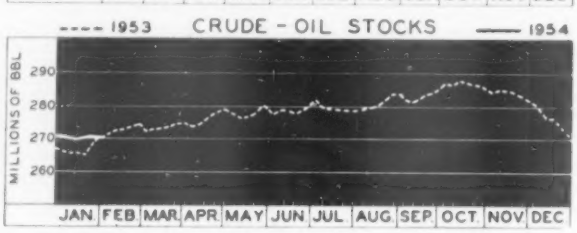


DAILY AVERAGE PRODUCTION FOR WEEK

	February 6			Jan. 30
	Crude oil	Lease condensate	total	total
Alabama	4,300		4,300	4,400
Arkansas	75,100	550	75,650	75,400
California	1,006,100		1,006,100	1,006,900
Colorado	111,200		111,200	112,600
Eastern	58,400		58,400	58,600
Florida	1,450		1,450	1,475
Illinois	171,100		171,100	172,200
Indiana	32,400		32,400	32,000
Kansas	297,600		297,600	269,400
Kentucky	33,800		33,800	33,600
Louisiana	626,000	46,600	672,600	679,750
North	106,000	3,600	109,600	109,700
South	520,000	43,000	563,000	570,050
Michigan	33,700		33,700	33,300
Mississippi	88,600	3,850	92,450	92,700
Montana	34,200		34,200	33,900
Nebraska	18,600		18,600	18,300
New Mexico	203,800	1,000	204,800	199,825
Oklahoma	518,700		518,700	521,400
Texas	2,612,400	53,000	2,665,400	2,667,350
Dist. 1	39,900	575	40,475	39,950
Dist. 2	134,800	7,800	142,600	141,125
Dist. 3	414,000	25,000	439,000	441,050
Dist. 4	239,500	6,300	245,800	247,100
Dist. 5	38,200	450	38,650	45,350
Dist. 6	108,500	5,700	114,200	118,100
East Texas field	227,000		227,000	231,000
Dist. 7-B	125,000	75	125,075	121,450
Dist. 7-C	175,000	4,850	179,850	178,125
Dist. 8	845,000	1,700	846,700	840,500
Dist. 9	185,000	500	185,500	185,050
Dist. 10	80,500	50	80,550	78,550
Utah	4,500		4,500	4,400
Wyoming	233,100		233,100	238,500
North Dakota	14,400		14,400	14,300
Total U. S.	6,179,450	105,000	6,284,450	6,270,300
Change from previous week,			up 14,150	
Canada	260,825		260,825	277,225
Total U. S. production January 1-February 6				232,704,000 bbl.
Same period last year (crude plus cond.)				*242,529,010 bbl.

*Includes 3,313,025 bbl. condensate.



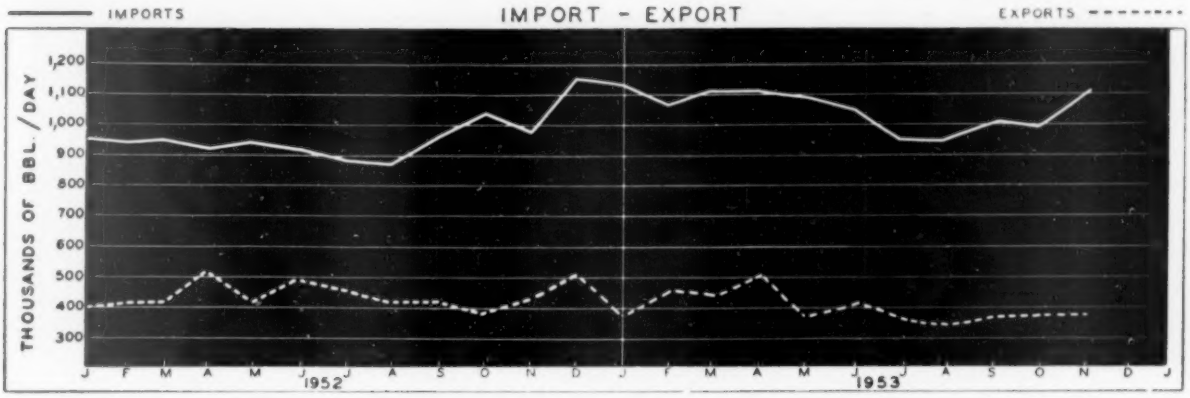


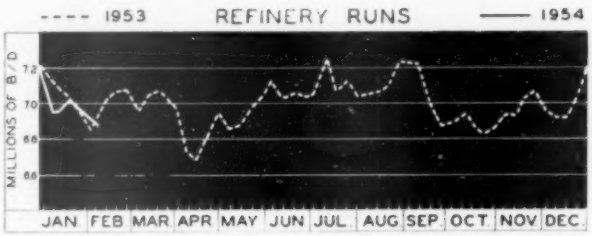
CRUDE-OIL STOCKS BY STATES OF ORIGIN*

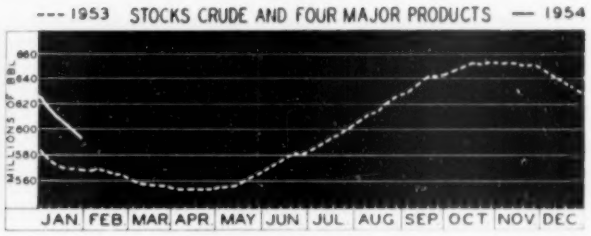
(Thousands of barrels)

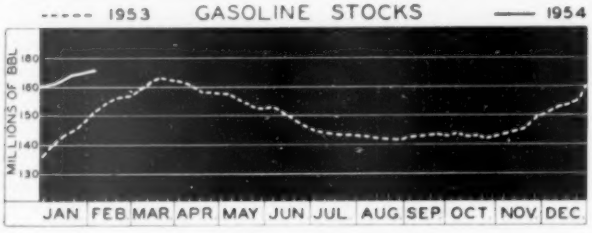
	Jan. 30, 54	Jan. 23, '53	Jan. 31, '53
Pennsylvania Grade	2,531	2,555	2,147
Other Appalachian	1,771	1,676	1,940
Illinois, Indiana, Michigan	11,667	11,464	9,829
Arkansas	3,317	3,296	3,176
Louisiana	15,218	15,968	15,364
North	2,786	2,812	2,515
Gulf	12,432	13,156	12,849
Mississippi	3,551	3,531	3,249
New Mexico	8,259	8,595	7,083
Oklahoma and Kansas	37,083	37,171	36,985
Texas	125,720	126,911	134,235
East Texas	10,898	11,186	11,169
West Texas	54,381	54,695	63,790
Texas Gulf	26,073	26,998	25,614
Other Texas	34,368	34,032	33,662
Rocky Mountain	16,994	16,680	15,127
California	33,494	33,060	33,108
Foreign	†10,663	10,162	8,398
Total	270,268	271,069	270,641

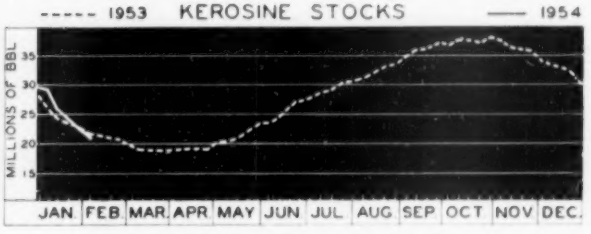
*Bureau of Mines. †Includes 2,717,000 bbl. in California.

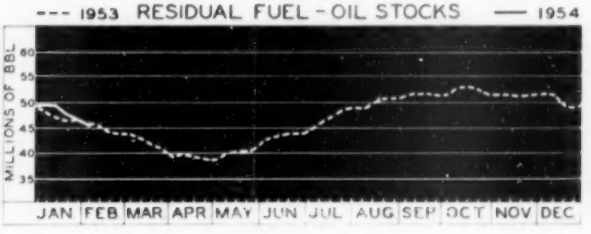










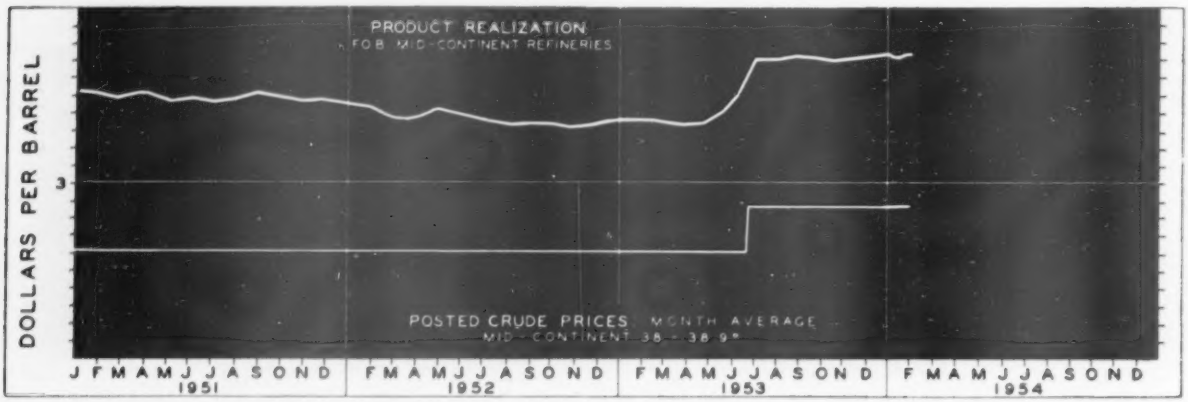


A.P.I. REFINERY REPORT, FEBRUARY 6

(Thousands of barrels)

District—	Daily avg. runs	Daily average production Gaso.*	Kero.	Dist.	Resid.	Stocks‡ Gaso.†	Kero.	Dist.	Resid.	Bureau of Mines, February 1953 Daily avg. runs	Daily average production Gaso.*	Kero.	Dist.	Resid.
East Coast	1,050	405.0	30.3	283.3	220.3	34,753	8,884	28,703	9,415	973	383.9	41.5	252.4	245.5
Appalachian:														
District 1	117	51.0	6.0	30.5	11.9	4,271	505	1,130	710	109	45.1	4.7	19.3	15.0
District 2	93	47.0	6.1	16.6	15.7	2,030	459	550	213	82	39.1	5.1	14.0	20.2
Ind., Ill., Ky.	1,321	719.4	86.6	257.7	181.8	36,553	5,155	12,246	4,112	1,252	664.9	84.4	232.8	196.9
Okla., Kans., Mo.	542	337.9	19.1	142.7	50.9	18,859	1,011	7,702	1,015	556	310.6	13.6	134.5	68.4
Inland Texas	240	186.1	9.0	43.7	25.3	7,087	273	1,277	1,254	251	176.1	15.2	40.2	41.2
Texas Gulf Coast	1,628	848.0	151.9	394.3	228.8	24,901	2,537	7,901	5,687	1,645	740.0	137.9	421.3	255.8
La. Gulf Coast	524	271.1	58.4	142.0	51.3	10,425	893	4,133	1,292	530	214.6	49.0	154.8	60.3
N. La. and Ark.	84	36.3	8.4	21.3	5.9	3,677	749	952	117	79	35.5	7.2	20.4	6.8
Rocky Mountain:														
New Mexico	18	11.9		2.6	2.4	212		50	35	17	10.6	0.5	2.5	3.9
Other Rocky Mtn.	240	117.7	7.0	54.3	39.9	7,106	171	2,013	722	217	99.2	6.9	48.8	47.7
California	1,022	446.3	8.3	179.3	387.1	22,098	419	11,811	21,313	962	389.5	4.4	187.1	360.8
Feb. 6, 1954	6,879	3,477.7	391.1	1,568.3	1,221.3	171,972	21,056	78,468	45,885	6,673	3,109.1	370.4	1,528.1	1,322.5
Jan. 30, 1954	6,948	3,390.1	383.1	1,469.9	1,187.4	170,421	22,093	83,936	46,433					
Feb. 7, 1953	6,834	3,318.9	383.4	1,454.0	1,258.3	152,493	22,308	78,152	45,807					

*At refineries including natural blended. †Finished and unfinished. ‡At refineries, bulk terminals, in transit, and in pipe lines.


PRODUCT REALIZATION
F.O.B. MID-CONTINENT REFINERIES
DOLLARS PER BARREL
3
POSTED CRUDE PRICES MONTH AVERAGE
MID-CONTINENT 38 - 38.9°
J F M A M J J A S O N D
1951
F M A M J J A S O N D
1952
F M A M J J A S O N D
1953
F M A M J J A S O N D
1954

In this trend chart refinery realization is based on average Mid-Continent grade crude oil (not 38° gravity only) and average prices for refinery products as published in The Oil and Gas Journal basis Oklahoma (Group 3). Refinery yields confined to gasoline, kerosine, distillate and fuel oil. Realization averaged $3.76 for week ended January 30, $3.75 for previous week, and $3.36 for January 1953. The above trend information is based on volumes and current prices and therefore does not reflect changes in operating costs.

REPRESENTATIVE QUOTATIONS

Representative spot-market quotations of leading suppliers as of February 10, 1954. Figures are f.o.b. plant for tank-car shipments in cents per gallon, except for residual fuel oil which shows the price per barrel and wax, in cents per pound.

GASOLINE, KEROSINE, AND FUEL OILS

	Mid-Continent Group 3	New York Harbor (barge)	Texas Gulf Coast
Regular gasoline	10.75-11	12-12.75	10.50-10.75
Premium gasoline	11.75-12	13.5-14.25	11.75-12.25
42-44 w.w. kerosine	9.125-9.375	10.9	9.5-9.75
No. 2 straw fuel oil	8.25-8.375	9.9	8.5-8.75
No. 6 residual	$1.45-1.55	$2.25-2.40	$1.85-1.95

NATURAL GASOLINE

	Group 3	North Texas	N. La.
Grade 26-70	5.0	4.5	4.75
Grade 18-55	6.0	5.5	5.75

LUBRICATING OILS
South Texas

200 vis., No. 2-3 neutral	12.5
750 vis., No. 3-4 neutral	15.5
2,000 vis., 5-6 neutral	17

LUBRICATING OILS
Mid-Continent

150-160 vis., D bright stock, 0-10 pp.	19
200 vis., No. 3 neutral, 0-10 pp.	14.25

Western Pennsylvania

145-155 vis., 10 p.t. bright stock	19.5
180 vis., 10 p.t. neutral	22.5

WAX
Mid-Continent

132-134 A.M.P.	6.0

GASOLINE markets continued the downward trend, particularly on the Gulf Coast and East Coast. Some suppliers are continuing a posting of 12.375 cents a gallon for unbranded regular gasoline for barge delivery in New York Harbor, but so much material is available at prices well below this level that the posting cannot be considered the spot-market low.

Regular-grade gasoline on the Gulf Coast is weaker but without any further break in the cargo price. Gasoline testing about 87-88 octane is available at 10.5 cents a gallon. This material will meet competition in many areas on the East Coast. This grade is used as the basis for the spot-market low since it is the normal regular for the area.

However, some lower-octane regular is available on the Gulf Coast at prices less than 10.5 cents a gallon. Reports indicate that some of this material is being offered for barge movement up the river in competition with some of the unbranded regular from the Mid-Continent. The availability of this material is another influencing factor in the downward trend of Group 3 gasoline prices.

Some Mid-Continent suppliers report that the Group 3 gasoline market has not moved any lower in the past week. The slightly better tone seems to be due to two factors related to pipe-line movements. There has been a reduction in the amount of gasoline either on demurrage or about to go on demurrage in the Great Lakes pipe line. Some of this was due to a reduction in tenders of gasoline in January. Also, with the free-storage period for gasoline starting with the first of February, more gasoline is now moving to pipeline terminals for storage until the start of the motoring season, leaving a little more space at refineries.

The better tone may last until refiners' storage fills again. The critical period will come in March.

CRUDE PRICES
GRAVITY SCHEDULE

	Signal Hill, Calif.*	Oklahoma, Kansas	Gulf Coast Tex.†	West Tex ‡
14-14.9	$1.87	....	....	....
15-15.9	1.93	....	....	....
16-16.9	1.99	....	....	....
17-17.9	2.05	....	....	....
18-18.9	2.11	....	....	....
19-19.9	2.18	....	....	....
20-20.9	2.24	$2.50	....	$2.37
21-21.9	2.30	2.52	....	2.39
22-22.9	2.37	2.54	....	2.41
23-23.9	2.45	2.56	....	2.43
24-24.9	2.53	2.58	$2.91	2.45
25-25.9	2.61	2.60	2.93	2.47
26-26.9	2.69	2.62	2.95	2.49
27-27.9	2.76	2.64	2.97	2.51
28-28.9	2.83	2.66	2.99	2.53
29-29.9	2.91	2.68	3.01	2.55
30-30.9	2.97	2.70	3.03	2.57
31-31.9	3.04	2.72	3.05	2.59
32-32.9	3.12	2.74	3.07	2.61
33-33.9	....	2.76	3.09	2.63
34-34.9	....	2.78	3.11	2.65
35-35.9	....	2.80	3.13	2.67
36-36.9	....	2.82	3.15	2.69
37-37.9	....	2.84	3.17	2.71
38-38.9	....	2.86	3.19	2.73
39-39.9	....	2.88	3.21	2.75
40 and above	....	2.90	3.23	2.77

*Standard Oil Co. of California. †Upper Texas Gulf Coast ‡Includes New Mexico Permian.

Prices East of California effective June 15, 1953. California prices effective February 16, 1953. Pennsylvania Grade prices effective January 1, 1954.

FLAT CRUDE PRICES

Representative posted schedules per barrel.

Louisiana:	
Cotton Valley (distillate)	$3.00
Cotton Valley (Holloway crude)	2.95
Texas:	
East Texas	2.90
Chapel Hill	2.83
Conroe	3.13
Van	2.73
Pennsylvania Grade:	
Bradford	3.76
Middle District	3.70
Southwest Pennsylvania	3.31
West Virginia	3.25
Ohio	3.24
Illinois Basin	3.02

Your MARKET PLACE FOR THE OIL AND GAS INDUSTRY...

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UNDISPLAYED CLASSIFIED 20c a word one issue. 10% Discount three or more consecutive issues. $4.00 minimum charge. Blind Box in our care nine words. Payable in Advance.

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$14.00 a column inch one issue . . .
10% Discount three or more issues.

Address Classified Advertising Material: The Oil and Gas Journal, P. O. Box 1260, Tulsa 1, Okla.

HELP WANTED

PROCESS ENGINEER: Young man, under 35, with Degree in Chemical Engineering or Petroleum Engineering (Refinery). Up to 3 years experience in oil refinery process work desirable but not absolutely necessary. Permanent position with a Texas Gulf Coast refinery. Please give complete personal resume. Box G-881, The Oil and Gas Journal, Tulsa, Oklahoma.

GRADUATE CHEMICAL ENGINEER: 5-10 Year experience required in design, technical service or operations, preferably in oil industry. Varied and responsible work in a growing consulting engineering firm specializing in chemical engineering service to oil and allied industries. Report writing ability essential. Travel about ¼ of time. Location pleasant Eastern residential city. Box G-938, The Oil and Gas Journal, Tulsa, Oklahoma.

ENGINEERS, Executives, Technical Men. Salaried positions—$3600 to $30,000. This confidential service for outstanding men who desire a change of connection. Will develop and conduct preliminary negotiations without risk to present position. Send name and address for details. Tomsett Associates, 434 Frick Bldg., Pittsburgh 19, Pa.

WANTED: Manufacturers representative for Chemical Company for State of Texas. Chemical or engineering background and oil field following important. Give details and background first letter. Box G-912, The Oil and Gas Journal, Tulsa, Oklahoma.

EXPLORATION MANAGER

Must have 5 years' Executive Geological Background and extensive Lease Trading experience.

SALARY: to $20,000

This position is with a well established Independent Oil Company.

CHAS. J. LOVELESS, Personal Service
616 S. Main Tulsa, Oklahoma

EQUIPMENT INSPECTION ENGINEERS

SOUTH AMERICA

A major oil company affiliated with Standard Oil Company (N. J.) needs graduate engineers with several years' refinery process equipment inspection experience. Must be qualified to interpret codes and specifications, predict equipment renewals, and recommend replacement equipment.

Write giving age, marital status, education, and full details of experience.

Box 308-O
Radio City Station
New York 19, N. Y.

HELP WANTED

FOREIGN EMPLOYMENT. List of oil companies and drilling contractors showing where to apply for foreign jobs. OIML Co., Box 2603, Tulsa, Okla. $5.00 cash.

SEISMIC SUPERVISOR required by expanding and aggressive seismic contracting company. Should have ability to supervise any domestic area and have good professional contacts. Minimum requirements: college degree in geophysics or related fields and eight years' seismic experience. Good future. Tulsa location. Box G-705, The Oil and Gas Journal, Tulsa, Oklahoma.

THE DEPARTMENT of Petroleum Engineering of a large state university is in need of a full time professor to teach logging and other courses in the application of engineering to geology. The research interest is unspecified but is hoped to be in geological engineering. Salary and rank open. Opportunity for company employment or sponsored research during the summer. Location South. Reply to Box G-920, The Oil and Gas Journal, Tulsa, Oklahoma.

Micropaleontologist

Preferably with an advanced degree and a minimum of 5 years' commercial or academic experience. To work in the New York research laboratory of a major oil company. This position demands broad interests in Stratigraphy and Biofacies and the capacity to do independent work on projects assigned. Salary dependent on experience and qualifications.

Write giving personal history and work experience. Please include telephone number.

RECRUITING SUPERVISOR
BOX OGJ

Arabian-American Oil Company

505 Park Avenue
New York 22, N. Y.

HELP WANTED

CHEMICAL ENGINEER with broad experience in petroleum refining processes and sales of licenses to foreign prospects, willing to travel worldwide. Salary and incentives commensurate with qualifications. All applications strictly confidential. Box G-927, The Oil and Gas Journal, Tulsa, Oklahoma.

WANTED: Sales Personnel for expanding oil well equipment company. College graduates, age 25-35. Salaries about $500.00 plus bonus and benefits. Send qualifications summary to Box G-934, The Oil and Gas Journal, Tulsa, Oklahoma.

SEISMOLOGIST

Major oil company needs experienced record interpreter with minimum of 2½ years' seismograph experience and 6 months record picking. Our employees know of this ad.

Box G-932
The Oil and Gas Journal
Tulsa, Oklahoma

DESIGNERS

Work on the engineering of oil-refineries and chemical-plants. Opportunities for qualified structural and civil engineers.

C F BRAUN & CO
Engineers • Constructors
1000 SOUTH FREMONT
ALHAMBRA,
CALIFORNIA

HELP WANTED

OIL INDUSTRY Employment Service. Tom Robinson, owner, 405 Tuloma Bldg., Tulsa, Oklahoma. For technical and trained oil industry personnel. Write for blank.

CHIEF CHEMIST experienced in Pod column work and gasoline plant process and product control testing to take charge of laboratory located at large gasoline plant in West Texas. Housing furnished and salary to be commensurate with qualifications of applicant. Please furnish experience record and salary expected. Our employees have been notified of this advertisement. Box G-776, The Oil and Gas Journal, Tulsa, Oklahoma.

SALES REPRESENTATIVES WANTED. Manufacturer of Oil and Gas Separating, Treating, and Metering Equipment wants commission Sales Representatives for following territories: (1) Louisiana, (2) West Texas, (3) East Texas, (4) North Texas, (5) Illinois, Indiana, and Kentucky, (6) Williston Basin, and (7) California. Territories available on exclusive contract basis to qualified salesmen. Please give details concerning present sales coverage, lines currently handled, and sales personnel when answering. All replies confidential. Box G-929, The Oil and Gas Journal, Tulsa, Oklahoma.

WANTED: Cable tool drillers on the Bucyrus-Erie Spudder Machine, drilling water wells. Steady work. Egerer-Galloway Well Corporation, 1012 North Third Street, Milwaukee 3, Wisconsin.

EXPERIENCED OPERATORS & MAINTENANCE MEN for new small refinery being completed March 1954. Texas MEK dewaxing process. Send statement of qualifications to P.O. Box 863, Salt Lake City, Utah.

ASSISTANT CONTROLLER

Independent oil producing company desires employ experienced oil accountant as assistant controller. Furnish full details as to experience, education, marital status, age, salary desired, references, etc., in first reply. References will not be contacted until interview granted. Answer by letter only to:

T. W. MOHLE & COMPANY
Certified Public Accountants
736 Bank of Commerce Building
Houston 2, Texas

PETROLEUM OR RESERVOIR ENGINEER

For New York office of major foreign producer. Proficient in mathematics with 4 or more years' extensive experience in oil and gas reservoir engineering on primary and secondary recovery problems. Duties will include preparations of basic field production and reservoir data for application in analogue and digital computors, performance of analytical analysis of field behavior and interpretation and preparation of resulting data for reservoir engineering reports on specific fields.

Write giving full particulars regarding personal history and work experience. Please include telephone number.

RECRUITING SUPERVISOR
BOX OG-1
Arabian American Oil Company
505 Park Avenue
New York 22, N. Y.

HELP WANTED

WANTED: Person experienced in the development, improvement and evaluation of petroleum products (not petrochemicals). Southwestern location, small community, integrated oil company of moderate size. Opportunity for advancement and supervisory experience. Box G-888, The Oil and Gas Journal, Tulsa, Oklahoma.

THE POSITION YOU WANT: Oil industry companies are looking for men to fill every conceivable kind of position. If you didn't find the position in this column that you are looking for, use a "Situation Wanted" classified advertisement to state your qualifications. Some company is probably looking for your ability. See box heading for classified rates or write The Oil and Gas Journal.

ENGINEERS

Foreign service. Graduate Chemical, Mechanical, Electrical & Construction Engineers with minimum 5 years' experience. For specialized assignments commensurate with qualifications in various phases of construction, estimating materials and cost control, planning and refinery process work. Write giving full particulars regarding personal history and work experience. Please include telephone number.

RECRUITING SUPERVISOR, BOX OG-3
Arabian American Oil Company
505 Park Avenue
New York 22, N. Y.

WANTED IN CANADA

EXPERIENCED MAUFACTURER REPRESENTATIVE IN CANADA DESIRES ADDITIONAL ACCOUNTS. MANUFACTURERS NOW REPRESENTED INCLUDE GRAY TOOL CO. AND VENTURA TOOL CO. BEST OF REFERENCES.

LEIDECKER TOOL CO. LTD.
6921 104TH STREET
EDMONTON, ALBERTA CANADA
PHONE 35016

PUBLIC UTILITY ENGINEER

Large, long established natural gas company in the West has an opening for an experienced senior staff engineer; one who under the management can plan and supervise the preparation of regulatory and rate matters, personally testify before commissions and assist the management in problems of utility operations. It is essential that the applicant understand gas distribution and transmission operations, have a comprehensive knowledge of public utility requirements and experience in processing matters before commissions or public bodies. Position is permanent and salary is open.

All replies will be confidential with the executive head of the company.

Box G-933
The Oil and Gas Journal
Tulsa, Oklahoma

FOR TRADE

WILL TRADE OIL PAYMENT and or lease interest for complete portable rig with all equipment including pipe. Box G-922, The Oil and Gas Journal, Tulsa, Okla.

SITUATIONS WANTED

PETROLEUM ENGINEER and Attorney; B.S. degree and Member Texas Bar; 7 years Oil Industry practically all phases. Box G-911, The Oil and Gas Journal, Tulsa, Oklahoma.

ATTENTION: Well established oil well drilling contractor desires to manage and supervise. Individuals', groups', small or medium-sized oil companies' drilling, production and operating problems in Central and Western Texas and New Mexico. Personal interview by appointment is desired. Makin Drilling Company, Box No. 1628, Ph. No. 3-3141, Hobbs, New Mexico.

PRODUCTION ENGINEER or production foreman with 8 years' foreign experience and 18 years in the States. Wide experience in well completions, workovers, gas lift, strata frac and all secondary recovery. On foreign service handled all phases as supervisor, such as office management, transportation, public relations, personnel, as well as items listed above. Will consider domestic or foreign service. Box G-906, The Oil and Gas Journal, Tulsa, Oklahoma.

GEOLOGIST: Would like to represent aggressive independent in West Central Texas or North Central Texas. Conscientious and dependable. Salary or retainer. Would relocate. Rely to Box G-914, The Oil and Gas Journal, Tulsa, Oklahoma.

MECHANICAL ENGINEER—28, Single, now employed by major oil company. 3½ years field and office experience. Desires responsible position domestic or foreign. Complete resume upon request. Box G-930, The Oil and Gas Journal, Tulsa, Oklahoma.

PIPELINE SUPERINTENDENT: Twenty years diversified experience supervising the construction, operations, maintenance of gathering systems, pump stations, deep water terminals, large diameter crude oil and product pipe lines. If you want experienced supervision that can organize and train personnel, maintain good management-labor relationship, write for interview. All inquiries kept confidential. Present position limits income growth. Excellent references available. Box G-925, The Oil and Gas Journal, Tulsa, Oklahoma.

DRILLING PRODUCTION ENGINEER, 30, married, 4 years major, 1 year foreign, Master's degree in M.E., desires immediate employment. Box G-939, The Oil and Gas Journal, Tulsa Oklahoma.

DISTRICT LANDMAN: presently employed, 33, married, Attorney, ambitious, youthful, yet mature and experienced. Leasing, Titles, Well Deals, Farmouts, Unitization. Desire change. Box G-940, The Oil and Gas Journal, Tulsa, Oklahoma.

PETROLEUM GEOLOGIST. Experience in subsurface and regional studies. Age 27, single, Masters degree. Desires permanent position with progressive oil company. Box G-931, The Oil and Gas Journal, Tulsa, Oklahoma.

PETROLEUM ENGINEER: Presently employed by major oil company, desires change in connection. Eight years varied experience in production and engineering operations. Box G-935, The Oil and Gas Journal, Tulsa, Oklahoma.

PETROLEUM GEOLOGIST desires work Rocky Mountain area or foreign. Master's Degree, experienced well-sitting, surface and subsurface exploration, scouting. Box G-936, The Oil and Gas Journal, Tulsa, Oklahoma.

THE RIGHT MAN: Can you fill the position you have open from the qualifications listed in this column. Men are always looking for an opportunity to improve themselves. Use a "Help Wanted" Journal classified advertisement to find the men you need. See box heading for classified rates or write The Oil and Gas Journal.

EQUIPMENT FOR SALE

FOR SALE: 2000 ft. 3½" bottle neck drill pipe, very good condition. $1.25 per ft. 1 set of 3½ to 5" tongs, $350.00. 1 4000 ft. brier swivel, $400.00. 1 GAK Waukesha 165 hp. mtr. with starting motor, $1650.00. Or will trade for casing or 2" upset tubing of equal value. F. H. Graves, P. O. Box 583, Phone 4726, Ardmore, Oklahoma.

SHRIVER 42" x 42" cast iron Filter Presses. Plate & Frame Type; 15—Sperry 18" x 18" cast iron Filter Presses, 11 chambers; #12 Sweetland Filters. Immediate shipment. Attractively priced. Consolidated Products Co., Inc., 150 Observer Highway, Hoboken, N. J. N.Y. Tel. BArclay 7-0600.

EQUIPMENT FOR SALE

5 KW OIL FIELD Type light plant—purchased new—used 18 months. MERIDIAN DRILLING CO., INC. Telephone CE 2-2055, Oklahoma City, Oklahoma.

40 ea. Cable Tool Stems—4" to 5½" O.D. 20 ea. 5½" x 36" Fishing Jars W/3¾" Joints. 95 ea. Bailers—4¼" to 10" O.D.—25' to 70' Lengths. 84 Sand Pumps—Spang—Larkin—Miller—All Sizes. Well Servicing Units—All Sizes—Truck Mounted or Skid Units. RL Cardwell Double Drum Spudder—Excellent Condition. General Tool & Supply Co., Box 4387, Oklahoma City, Oklahoma.

SALES and rentals of cable drilling and fishing tools, casing and equipment, from the Southwest's largest stock of used cable tools and oil field supplies. Degen Pipe and Supply Co., Tulsa, Oklahoma.

NEW 12¾ SEAMLESS COUPLINGS $5.50 each. Edco Pipe & Supply, Box 151, Tulsa, or phone 4-5970.

Gaso Duplex 4½" x 6" Power Pumps with Chrysler C-36 Engines, skid mounted, immediate delivery. Also Byron Jackson, Carter Centrifugal Units. Westinghouse 20-25-50 KW Generating Units.

H. H. COFFIELD
Attn.: W. H. ORR
Phones: 132—Rockdale, Texas
AT-3427—Houston, Texas

FOR SALE

COMPRESSOR PLANT COMPLETE with SEVEN 200 H.P. Clark Bros. horizontal twin gas engine compressors, buildings, pumps, pipe, valves, fittings, and Alco Air Fin Coolers for jacket water. Located West Texas.

C. J. SMITH
304 Oil Capital Bldg.
Phone 54-4416
Tulsa, Oklahoma

PACKAGED GAS DESULFURIZATION UNITS

All sizes for pipe line and fuel gas requirements.

WRITE—WIRE—PHONE

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Dallas, Texas
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for the entire industry

Lease-Well, Sales Promotion, Safety

Quality———Economy

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Sand Springs—Box 448

EQUIPMENT FOR SALE

FOR SALE: 5½" x 20" class 'Y' Cooper Cylinders, 11" x 16" Superior Cylinders, 8" x 10" XGB Cylinder, Electric Driven Centrifugal Pumps, 125 KW Generator, 4"—500 lbs. rising stem gate valves. Alfred B. Kern, 223 Wright Bldg., Tulsa 3, Oklahoma.

3800' 2⅞" O.D. 6.50# J-55 Rge 2 Hydril Type "A" Thd. Tubing. Arnold Pipe & Supply Co., 3815 Greenwood Rd., Shreveport, La.

$2500.00 will buy 26 Lee C. Moore 67 foot tubular derricks standing on Louisiana Lease. Seymour Van-Os, Box 626, Phone 2351, Kilgore, Texas.

SACRIFICE AT FRACTION OF ORIGINAL COST: 23 K.W., AC, 110-220V generator powered by International U-9 engine equipped to burn gasoline or natural gas. This Ready Power Unit has been used only 129 hours. It was used as a standby. Engine could be used to pump fair sized irrigation well. Unit can be seen at Hugoton Production Company gasoline plant 8 miles south of Ulysses, Kansas. Price $1,000. Address inquiries to Hugoton Production Company, Garden City, Kansas.

REDA PUMP complete w/#4—20 Motor 45⅓ H.P., 650 Volt, 41.6 Amps. #90—Pump Housing, #5595—Switchboard w/recording Ammeter 3400'—#4 Cable 125 Amp. Auto Transformer Accessories. Engine 225 H.P. Climax Type R-225 on Skid. Alternator G. E. 125—KVA. 100 KW, 440 V. A. C. w/Transformer, Flexible coupling and skid base. House—10' x 18' wood frame, w/G.I. Roof and Siding on Skid. Engine—165 Hp Climax R-61 on Skid. Herndon Drilling Co., 421 Mayo Bldg., Tulsa, Phone 4-9700.

Cuts Drilling Cost!

ARMITE DRILL COLLAR & TOOL JOINT COMPOUND

ARMITE LABS., 6509 Broad St., Los Angeles 1, Calif.
J. B. Carver Jr., 1103 E. Maple, Midland, Tex.

FOR SALE

Two model O-7 Murry and Tregurtha Harbormaster outboard propulsion units with twin 6-71 GM diesel engines. Each unit rated 330 HP. Designed for remote control starting, stopping and steering. Complete with barge mounting plates. Price reduced.

Four ZP Viking rotary pumps equipped with 36" 10 groove "D" section sheaves, together with three 75 HP 220/440 volt, 1175 rpm electric motors with sheaves and belts for driving pumps. Pump capacity 1050 gpm, 50 psi.

Four 8GR Worthington rotary pumps, capacity 1000 gpm at 200 psi, skid-mounted with sheaves and V-belts. Also four 6GR Worthington pumps, capacity 700 gpm at 200 psi. Two 5GR Worthington pumps, capacity 400 gpm at 200 psi. Ten 4GR Worthington pumps, capacity 200 gpm at 200 psi.

Six 3ugl and 4ugl Worthington centrifugal pumps mounted on steel base, capacity 1100 gpm at 300 psi.

One 10" x 18" Gaso piston pump mounted on skids, capacity 700 gpm at 125 psi.

SOHIO PETROLEUM COMPANY
407 N. 8th Street, St. Louis 1, Missouri
Attention: H. F. Fisher

EQUIPMENT FOR SALE

EVERYTHING in new and used equipment for well drilling. Fishing tools rented. Save money, get quotations from Pressey & Son, Pueblo, Colorado.

FOR SALE—At our Oklahoma City warehouse, 1 used Allis-Chalmers Model UE skid well servicing unit $850.00. Also, 1 Model UM Allis-Chalmers tractor well servicing unit, $850.00. Cities Service Oil, Patridge, Bartlesville, Oklahoma.

250,000 FT. 8⅝ o.d. pipe with collar and plain end. $1.00 per foot Oklahoma. Rogers & Lundquist, 620 Wright Building, Tulsa, Okla. Phone 3-2072—5-8850.

WANT EQUIPMENT: Did you find the equipment you wish to purchase in this column? If not, use an "Equipment Wanted" classified advertisement to find it. It is available somewhere and Journal classified advertisements will find it. See box heading for classified rates, or write The Oil and Gas Journal.

FOR SALE

COMPLETE COMPRESSOR STATION

Two 600 H.P. Type L.V.G. Ingersoll-Rand gas engines with high pressure compressors. Engines and compressors complete including Parkersburg Building. Located twenty miles from Houston. Contact—

PETROLEUM MANAGEMENT CO.
565 San Jacinto Building, Houston, Texas
Phone: CHarter 4781

FOR SALE

9 WORTHINGTON VACUUM PUMPS, Feathervalve, single cylinder, 25" dia. cylinder, 18" stroke.

38 BUFFALO GEAR PUMPS, size 1½" cap. 7½ G.P.M.

27 BUFFALO CO. TURBO FANS, type LL, size 3½" bore, conoidal fans.

37 STORAGE TANKS, 7' x 16', 95 barrel, horizontal, ¼" welded tank steel.

9 VACUUM STILLS, 9' x 30' max. press. 60-70 mm., hg. vacuum, max. temp. 660° F., approx. wgt. 36,000 lbs.

12 STEEL BOXES, 8' x 8' x 30', ¼" steel plate.

1 SURGE TANK, 10' x 14'.

3 BAROMETRIC CONDENSERS.

1 HORIZONTAL TANK, 4' x 9'.

1 STEAM SEPARATOR.

1 VACUUM VAPOR CONDENSER.

Prices less than 25% of cost, condition mostly excellent. Located St. Louis District. Material recently dismantled from oil refinery. Many more items too numerous to classify. Write for complete list.

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2031 Railway Exchange Bldg.
St. Louis, Missouri
Garfield 2677

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Chicago, Illinois
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PIPE YARD—MIDLAND, TEXAS

- Five to 20 acres of land.
- One 5-room house with 2-car detached garage.
- Railroad spur available.
- 280' radio tower (optional).
- Water well.

Call, write or wire:

JIM MYERS or J. T. MILLER
Post Office Box 310, Midland
Phone 2-3711 or 4-6772

Eighty Thousand Barrel Wiggins Floating Roof Tank

API, all welded, 5 rings, 120'x40', located Ill., sell where is or cut down, reerect any place. Also 10,000—20,000—30,000 & 35,000 bbl. floating roof, 2—80,000 bbl. cone roof, 3—10,000 bbl. bolted tanks.

Phone 3-6141 W C. BERRY P. O. 1858 Tulsa

EQUIPMENT FOR SALE

FOR SALE: 2500 ft. Rotary Rig complete. 2442 ft. 4½" drill pipe. A bargain. Write L. O. Moore, 1010 East Main Street, Holdenville, Oklahoma.

EQUIPMENT WANTED

NOTICE: We buy. We sell equipment everywhere. If you want to sell or buy, contact Pressey & Son, Pueblo, Colorado.

WANTED: Used B. S. & B. or National Dehydrator Unit to handle 5 to 10 MMSCF of Gas per day, also same size scrubber, advise location, price and condition by letter, P.O. Box 103, Oklahoma City, Oklahoma.

WILL PAY highest prices for used casing, used line pipe, abandoned leases, or other surplus lease equipment. Your idle producing equipment is worth dollars. Green Pipe & Supply Co., Box 1383, Tulsa, Oklahoma

EQUIPMENT NOT IN USE: Did you find a buyer in this column for the equipment you have for sale. Someone wants it and an "Equipment For Sale" classified advertisement in the Journal will find a buyer. See box heading for classified rates or write The Oil and Gas Journal.

LEASE AND DRILLING BLOCKS

NEW MEXICO STATE LEASE, will sell 4,000 acre solid block semi-wildcat, good location. Box G-907, The Oil and Gas Journal, Tulsa, Oklahoma.

WILL pay cash instantly for leases (large blocks), royalties, mineral deeds, production. Write fully—P. O. Box 2153, Denver, Colorado.

PUT YOUR MONEY to work. See A. L. Bowles, Ada, Okla., for Oil Investments & Drilling deals. Quick Action.

FOR SALE: 125 acre Oil and Gas Lease in heart of activity, Shelby County, Texas. Price $5 per acre. Write for information to C. A. Parker, Box 507, Center, Texas.

FOR SALE: SHALLOW PRODUCTION in Kentucky. Write Harvey Daugherty, Horse Branch, Kentucky.

12 TO 15 BOPD for sale, two shallow wells, substantial reserves and acreage, new equipment, priced right, eastern Kansas, too far from our operation. Francis Claus, Union Trust Bldg., Rochester 14, N. Y.

160 A., DRILLING well. Up to 1000 bbls. originally ½ mile. Dutcher sand. 1/32-$200.00. 1/16-$375.00. L. Price, Coweta, Okla.

LOOKING FOR A LEASE? There will be over 40,000 wells drilled this year. If you are looking for a lease, drilling block, or drilling deal and haven't found it in this column, or if you have a lease or drilling block you want drilled, a Journal classified advertisement can find an interested party. See box heading for classified rates, or write The Oil and Gas Journal.

LEASES ROYALTIES

Producing and Nonproducing
Bought and Sold—Any Area
Inquiries Invited

B. D. BUCKLEY
6635 Delmar Ave., St. Louis 5, Mo.

WANT TO SPECULATE

Will sell wildcat oil and gas leases in West Texas County. These leases have four to five years to run. Most of them carry 50c rentals.

These leases are scattered throughout the county and are tracts of 160 acres and more. All leases surrounded by major oil companies.

Big Reef pools already discovered in counties to the south.

1920 total acres at $7.50 per acre.
Box G-937
The Oil and Gas Journal
Tulsa, Oklahoma

LEASE AND DRILLING BLOCKS

480 ACRE drilling block, Township 5, Range 20, Beaver County, Oklahoma. On direct trend with Huber, Light, and Texas Company, Cook, Johnson, and Eldridge wells. E. H. Huebner, Turpin, Oklahoma.

IF YOU HAVE A LEASE BLOCK—good geology—located North Texas—preferably shallow drilling—will consider proposition. Box G-921, The Oil and Gas Journal, Tulsa, Oklahoma.

ROYALTIES

FREE TAX INFORMATION for those desiring to sell their producing royalties, overrides or production. Robert L. Kinkaid, Box 26, Tulsa, Oklahoma.

OFFERING CHOICE ROYALTIES on geology in Oklahoma's greatest oil fields. A. S. Berry, 522 Wright Bldg., Phone 5-5402. Tulsa, Oklahoma.

GET TOGETHER: Both Capital and Royalties are available. If the investment proposition you want isn't listed in this column, use a Journal classified advertisement to find it. See box heading for classified rates, or write The Oil and Gas Journal.

FOR SALE OR LEASE

FOR SALE OR LEASE: 3660 acres land in woods with 360 acre reservoir for duck hunting, 11 miles southwest of Stuttgart, Arkansas, 3 miles southwest of Lion Oil Company duck hunting reservation. Write W. H. Arnold, Box 781, Jonesboro, Arkansas.

FOR SALE OR LEASE: Federal Lease Oil and Gas—80 acres Sweetwater County, Green River Basin, Wyoming, Township 13 North, Range 100W, Section 27, NE¼, NW¼ Section 34, NE¼ NW¼, also State of New Mexico Lease 40 acres Otero County, New Mexico. Section 29, Township 15S, Range 12E, subdivision NE¼, SE¼. Write L. E. Griffeth, 200 Candler Street, Winder, Georgia.

ELECTRICAL CONTRACTORS

Office Phone 5-5315 — **Res. Phone** 7-4950

W. L. RATCLIFF COMPANY
ELECTRICAL CONTRACTORS
Industrial—Commercial—Distribution

W. L. Ratcliff — **506 Caddo St.**
P. O. Box 373 — **Shreveport, La.**

BUSINESS OPPORTUNITIES

OIL EQUIPMENT AND SPECIALTY MANUFACTURERS—Wanted: Specialty Products for drilling and production, to handle on straight commission or as distributor. Area: Texas Gulf Coast, with other outlets throughout Texas. Facilities include sales personnel, warehouses, trucks. Gordon B. Nicholson, Tri-State Engineering & Service Co., Box 9083, Houston, Texas.

CASH AVAILABLE

For Purchase of Producing Oil & Gas Properties

Principals require attractive investment opportunities. Complete information necessary.

Box G-854

The Oil and Gas Journal

Tulsa, Oklahoma

REAL ESTATE

SPACE IS NEEDED: A Journal display classified advertisement is the quickest way to rent or sell your real estate. In the present period of expansion oil industry firms urgently need the space you have available. If it isn't listed here, you may also find it by stating your needs in these pages. For classified rates see box heading or write The Oil and Gas Journal.

WILDCAT COMPLETIONS

(Continued from page 236)

Hodgeman County: Armer 1 Smalley "C," SE NE SE 9-23s-24w. Dry. TD 4,725 ft.

Ness County: Globe Construction Co. 1 Castor, NE NE NE 32-17s-26w. Dry. TD 4,526 ft.

Pawnee County: Natural Gas & Oil Corp. 1 Wesley, SW SE SW 11-22s-15w. Dry. TD 4,016 ft.

Stafford County: Heathman & Seeligson 1 Prescott, NE NE SW 18-23s-14w. Dry. TD 4,125 ft.

NEBRASKA

Kimball County: Rogers Oil 1 Wollsey, NW NE NE 13-12n-56w. Dry. TD 6,564 ft. "J" sand 6,442 ft.

SOUTH DAKOTA

Meade County: Lion Oil 1 Government-Libertin, SW SW NE 9-4n-11e. Dry. TD 4,346 ft. Madison 4,272 ft.

CALIFORNIA

Kern County: Lewis Soloman 1 Shearer, 23-29s-27e. Dry. TD 4,722 ft.

Humble Oil & Refining Co. 17 K.C.L.-B., 34-11n-21w. Dry. TD 6,032 ft.

The Texas Co. 2 Krauter, 14-31s-29e. Dry. TD 6,136 ft.

Kings County: W. W. Holmes, Opr., 2-32 Whittier, 32-23s-22e. Dry. TD 3,650 ft.

Tulare County: Ohio Oil Co. 1 J. C. Phillips, 12-24s-24e. Dry. TD 9,464 ft.

MONTANA

Big Horn County, Superior area: George J. Greer, Trustee 6 Kendrick, NW NE SW 34-1n-34e. Dry. TD 4,236 ft. Charles 3,841 ft.

Musselshell County, E. Devils basin: Continental Oil 1 Staunton, C NE NW 14-10n-25e. Dry. TD 2,770 ft. Otter 2,685 ft.

Ivanhoe area: Flank Oil 1 Stensvad, SW NW SW 15-11n-31e. Dry. TD 5,194 ft. Kibbey 5,128 ft.

WYOMING

Crook County, Chicago Creek: Hunt Oil 1 Government-Miller, C NE NW 14-56n-61w. Dry. TD 3,793 ft. Deadwood 3,700 ft.

Natrona County, Lane Creek: Argo & Anschutz 1 Government, SW NW NW 12-40n-80w. IPF 70,000 cu. ft. g.p.d., shut in. Frontier 2,030 ft. Frontier discovery-new field. TD 2,102 ft.

Alkali Creek area: Sohio Petroleum 1 Government-Evans, SE NE SW 18-39n-83w. Dry. Tensleep 1,200 ft. TD 1,540 ft.

Niobrara County, Old Woman area: Schoonover Development 1 Government, NE SE SE 9-36n-62w. Shut in indefinitely. TD 1,790 ft. (?). First Leo sand 1,783 ft.

Dull Center: Trigood Oil 1 Government-Reed, C SE NE 35-41n-67w. Dry. TD 8,057 ft. Newcastle sand 7,998 ft.

Weston County, South Cheyenne River: Trigood Oil 1 Murray-Government, "A," C SW NE 27-41n-66w. IPF 129 BO in 3 hours, Newcastle discovery-new field. Newcastle 7,336-50 ft. TD 7,404 ft.

COLORADO

Adams County: Superior Oil Co. 48-6 Wailes, SE SE SW 6-2s-57w. Dry. TD 5,915 ft. Skull Creek 5,883 ft.

Elbert County: Ginther-Warren & Ginther 1 Carl Ward, C SE NE 29-10s-63w. TD 9,604 ft. Lyons 9,548 ft. Dry.

Kiowa County: Superior 65-23 Weisenberger, NW NE SE 23-19s-49w. Dry. TD 6,030 ft. Pre-Cambrian 6,025 ft.

Montezuma County, Montezuma Canyon: Hathaway-Cheyenne Oil Ventures & Big Horn Powder River Corp. USC 2, NE SW SW 12-37n-20w. Dry. TD 5,532 ft. Paradox 5,216 ft.

Morgan County: Huey, Clark & Denver Basin 1 Johnson, NW NW SW 24-2n-57w. Dry. TD 5,570 ft. "J" sand 5,469 ft.

Washington County: J. W. Hicks 1 Skiles, SW SE NW 30-1n-54w. Dry. TD 5,004 ft. Skull Creek 5,002 ft.

Weld County: Seneca Oil Co. 1 Kleff, NW NW SE 3-5n-61w. Dry. TD 6,945 ft. "J" sand 6,838 ft.

Plains Exploration Co. 1 G. C. Rothrock, SE SE SE 1-7n-57w. Dry. TD 6,084 ft. Skull Creek 6,075 ft.

Shell Oil Co. 1 McEndaffer "A," C NE NW 34-12n-56w. Dry. TD 6,325 ft.

SASKATCHEWAN

Socony-Sohio 1 Copeland, LSD 6, 13-30-20w2. Dry. TD 4,228 ft.

Socony-Sohio 1 Dilke, LSD 15, 5-21-12w2. Dry. TD 3,030 ft.

ALBERTA

Imperial 11-16 Demay, LSD 11, 16-47-19w4. Dry. TD 5,310 ft.

Shell-Peers 1 strat test, LSD 6, 21-53-14w5. Dry. TD 8,000 ft.

Socony-Seaboard 30-15 North Pembina, LSD 15, 30-49-8w5. Cardium oil well. TD 5,150 ft.

Ryerson Announces Alloy Steel Appointments

Robert L. Larson has been appointed manager of the alloy-steel division, Joseph T. Ryerson & Son, Inc., steel service organization. He was formerly manager of alloy-steel sales, Chicago plant. In his new position, he has responsibility for coordinating alloy-steel sales and related activities of the group of 16 Ryerson steel plants. His headquarters are in Chicago.

Succeeding Larson as manager of alloy-steel sales, Chicago plant, is William P. Loehrer. He was formerly a representative of the alloy and stainless-steel department.

Larson started with the company at Milwaukee in 1945. In 1946, he became a representative of the alloy-steel department in the Chicago area, and in 1950, was named manager of alloy-steel sales, Chicago plant.

Loehrer joined Ryerson at Chicago in 1947, as a member of the special-steels department. The following year he was appointed alloy and stainless-steel-sales representative, working out of the Chicago plant with headquarters in Rockford, Ill.

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THE LEAK AND SEEP CURE!

NOW! NATIONAL TANK COMPANY includes ALL neoprene (Buna N) gasketing with ALL National Bolted Tanks at NO increase in price.

NATIONAL TANKS ERECTED BY NATIONAL, ARE GUARANTEED LEAKPROOF

NEW HARDWARE FOR RESET TANKS INCLUDES ONLY NEOPRENE GASKETING

NEOPRENE TANK GASKETS

resists deterioration caused by:

1. Sour Oil
2. Aviation Fuels
3. High Propane Content Oils

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b. In Canada through National Tank Co., Ltd.
c. Export through National Supply Co., Export Division

NATIONAL TANK LEADS

National Tank Company, in only 28 years, has produced many 'firsts" for bolted tanks . . .

1. The First "Long Base" oval hatch.
2. The First anti-channel drain baffle.
3. The First extended cleanout box.
4. The First Neoprene ringlet and washer.

National Tank gave its assistance and knowledge in building the API bolted Tank and Flange program. This is the present API 12-B Standard and Armed Forces Standard.

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65 Bbl.	100 Bbl.	250 Bbl.	Lo 500 Bbl.	Lo 1000 Bbl.	5,000 Bbl.
130 Bbl.	200 Bbl.	Hi 500 Bbl.	2R1000 Bbl.	2000 Bbl.	10,000 Bbl.
195 Bbl.	300 Bbl.	750 Bbl.	1500 Bbl.	3000 Bbl.	

BE SURE TO ORDER TANKS ACCORDING TO API STANDARD 12-B 1953 EDITION

It's National®

NATIONAL TANK COMPANY

TULSA, OKLAHOMA

YOUNGSTOWN
Electric Weld
LINE PIPE
Uniformly satisfactory in service because—

1. Long lengths save time and trouble
2. Weldability is outstanding
3. It bends readily
4. Line up characteristics are excellent

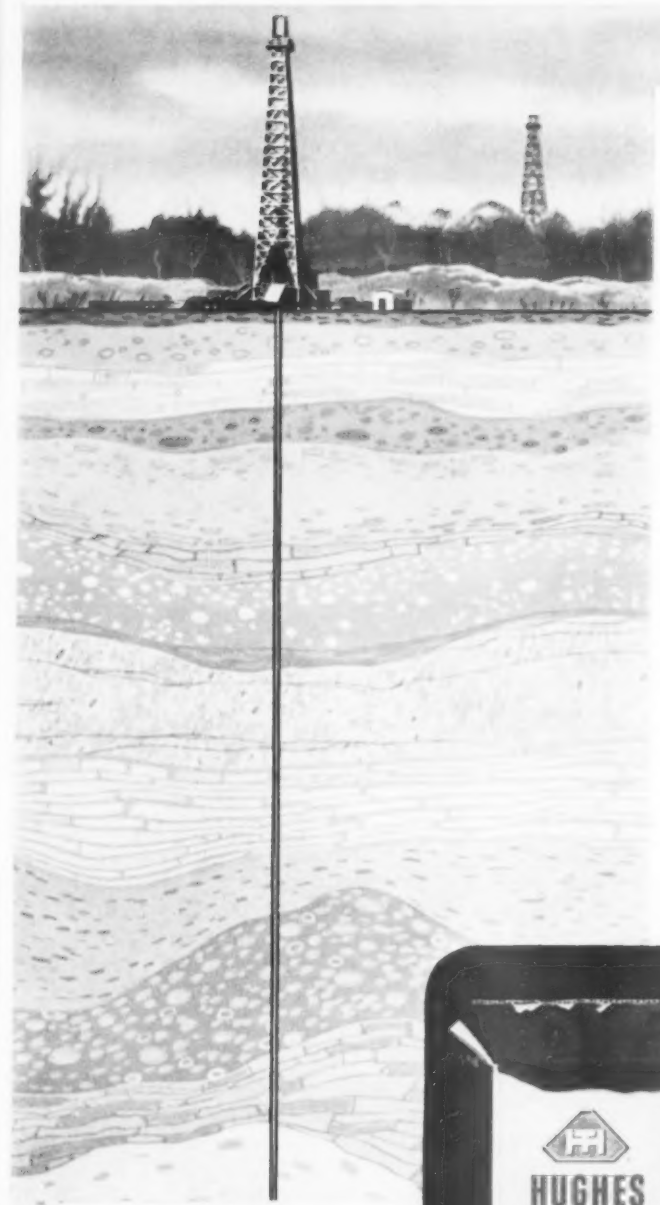
QUALITY YOUNGSTOWN SERVICE

PROVES EVERY LENGTH

●As a final check on its soundness, every length of Youngstown Electric Weld Pipe undergoes this hydrostatic test. Filled with water under high pressure, the pipe is struck repeatedly along the weld zone with pneumatic hammers. Only perfect pipe can survive such rigorous testing.

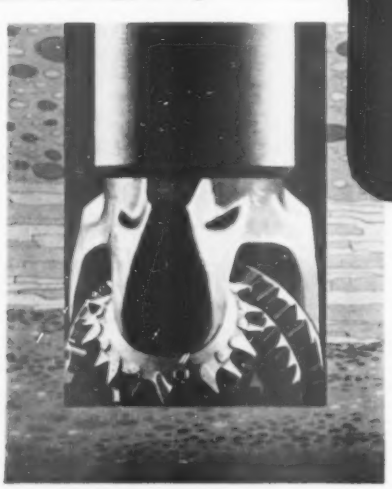
Youngstown Electric Weld Pipe for the oil and gas industry is being made in sizes up to 22" OD and in grades as high as X52. For further information, phone or write our nearest District Sales Office.

THE YOUNGSTOWN SHEET AND TUBE COMPANY *Manufacturers of Carbon, Alloy and Yoloy Steel*
General Offices: Youngstown, Ohio - Export Office: 500 Fifth Avenue, New York 36, N. Y.
PIPE AND TUBULAR PRODUCTS - CONDUIT - BARS - RODS - COLD FINISHED CARBON AND ALLOY BARS - SHEETS - PLATES - WIRE - ELECTROLYTIC TIN PLATE - COKE TIN PLATE - RAILROAD TRACK SPIKES



FROM TOP TO BOTTOM IT'S FASTER WITH HUGHES BITS

The consistently *faster penetration rate* of Hughes rock bits gets you from top to bottom in the shortest possible time.

The consistently *better footage* of Hughes bits gets you from top to bottom with fewer round trips.

That's why — year-in and year-out — operators use Hughes bits to drill more hole... faster! When you run Hughes bits, you get the benefit of the industry's greatest rock bit engineering, research and manufacturing experience . . . plus that dependable Hughes field service.